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THE UNIVERSITY OF ALBERTA

ENGINEERING DESIGN AND DRAFTING TECHNOLOGY

PERCEPTIONS OF CURRICULUM RELEVANCE

b y

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF EDUCATION

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AND

VOCATIONAL EDUCATION

EDMONTON, ALBERTA

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Engineering Design and Drafting Technology - Perceptions of Curriculum Relevance", submitted by Robert Eugene Juthner in partial fulfillment of the requirements for the degree of Master of Education.

K. Peifer
(Supervisor)

Henry B. Ziel

L. M. Morgan

Date: Oct. 19th, 1978

ABSTRACT

PURPOSE AND DESIGN

The purpose of the study was to determine the perceptions held by graduates from Engineering Design and Drafting Technology of the applicability of course content to their jobs. It was also a purpose of this study to identify desirable subject matter not covered by the curriculum at this time. It was predicted that certain experiential, level-of-employment, and specialization-related variables might reflect differences with respect to opinions on academic preparation.

A modified Q-sort was designed to determine what knowledges and skills were deemed from most to least important to graduates performing differing functions. Descriptions of items of course content were placed on cards to be sorted by the respondents into four categories: essential, related, somewhat related, and unrelated. A brief questionnaire was used for recording personal and employment data, and an interview was conducted with each respondent to elicit additional information.

PROCEDURES

Following the scrutiny by a panel of experts of the original items to be placed on cards, and subsequent revision, and a pilot sorting by instructors at N.A.I.T., the survey instruments were completed by 60 graduates working as Engineering Design and Drafting Technologists. Responses were key-punched for data processing, facilitating cross analysis of the variables with the card sort response patterns. Engineering specializations affecting these variables were: Civil/Municipal, electrical/electronic, mechanical, structural, and topographic.

FINDINGS

Findings of the study indicated few differences between the perceptions of instructors (of the pilot study), of graduates in supervisory positions, and of graduates in non-supervisory positions. It was also found that increasing responsibility and increasing years of experience did not lead respondents to rank abstraction items higher.

With respect to the five major areas of specialization, mentioned above, it was found that in four of these employees ranked their own specialty items higher than would all the others, while in one field no difference was found.

In identifying a common core curriculum it was found that instructors and supervisors more closely agreed than any of these two groups with employees in non-supervisory positions as to which of the items of the curriculum represented necessary core elements.

Based on the frequency rank order of all items, additional data were derived from the card sort with the special objective of isolating those ranked in the lowest quartile, upon which recommendations for curriculum revision are based.

Finally, additional descriptive data derived from the interviews are included for the perusal of the educator concerned with curriculum design and revision.

RECOMMENDATIONS

Based on the findings of the study, recommendations regarding changes in the curriculum are made, and these changes are presented in the form of a graphic overview of course and time allotments to represent the views of the graduates in regard to job relevancy of course content. In some instances, only minor changes (additions to or deletions from the present course content) are proposed, in other instances it is recommended to remove the entire course from the pattern of obligatory courses and offer it as an option, or elective course, to those students (nearing graduation) who expect employment in one of those particular fields. In one case (physics) a drastic change of course content is proposed. A new course, an option in office management and personnel supervision, is also recommended.

RECOMMENDATIONS

While, as suggested by the many high values assigned to "hands-on" or practical ("application") items contained in this study, curricular offerings should be kept functional, the inherent danger of obsolescence of a curriculum concentrating on present-day manual skills must be recognized. Therefore, and to provide constant feedback from industry, follow-up studies should be conducted at regular intervals. The card sort technique used in this study, updated and refined, could provide the tool with which to measure future curricular needs on a systematic basis.

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CHAPTER 1
INTRODUCTION

GENERAL

This study is concerned with curriculum validation of Engineering Design and Drafting Technology offered by the Northern Alberta Institute of Technology.

The program was instituted in 1963, and the first class of graduates entered industry in 1965. The present enrollment (1976/77) of first-year students is 72, and of second-year students is 53. (A graphical representation of enrollments from 1963 to 1976 is shown in Appendix A, p. 83.) At present four classes of first-year students and three classes of second-year students receive instruction in this technology.

At the conclusion of this two-year post-secondary program, the graduate is awarded a diploma in technology.

DESCRIPTION OF THE PROGRAM AT N.A.I.T.

In recent years, the expansion of industry in Alberta and in other Western Canadian provinces has created a shortage of personnel capable of designing, or interpreting into working drawings the designs of engineers, for buildings, bridges, roadways, utilities, subdivisions, extraction and manufacturing plants and many other works of an engineering nature. Canada Manpower records (Appendix B, p. 84) show that the graduates of this program have obtained immediate employment in federal, provincial and civic engineering offices, with consulting engineers, land surveyors, utility companies and manufacturing plants. To satisfy employers' expectations, the instructional staff, in consultation with the advisory committee of the technology, drawn from industry, have endeavoured to develop a curriculum, and to teach course content designed for the technologist level. The instruction proceeds beyond mere skill development and theoretical rudiments. Much emphasis is placed on academic content and on its application to the practice of drafting technology, so that the graduate shall be equipped, after appropriate experience, to assume a position of responsibility on the engineering team.

DEFINITION OF THE TECHNOLOGIST AND TECHNICIAN

Within the last two decades, distinctions between the levels of technician and technologist have gained general recognition. The levels and respective job titles, suggesting different educational background, and actual job function (if not even personal inclination toward the practical or theoretical end of engineering) including areas of overlap of duties regardless of academic qualifications, have been illustrated by "Gooding's Grid", below (Quittendon, 1970, 7):

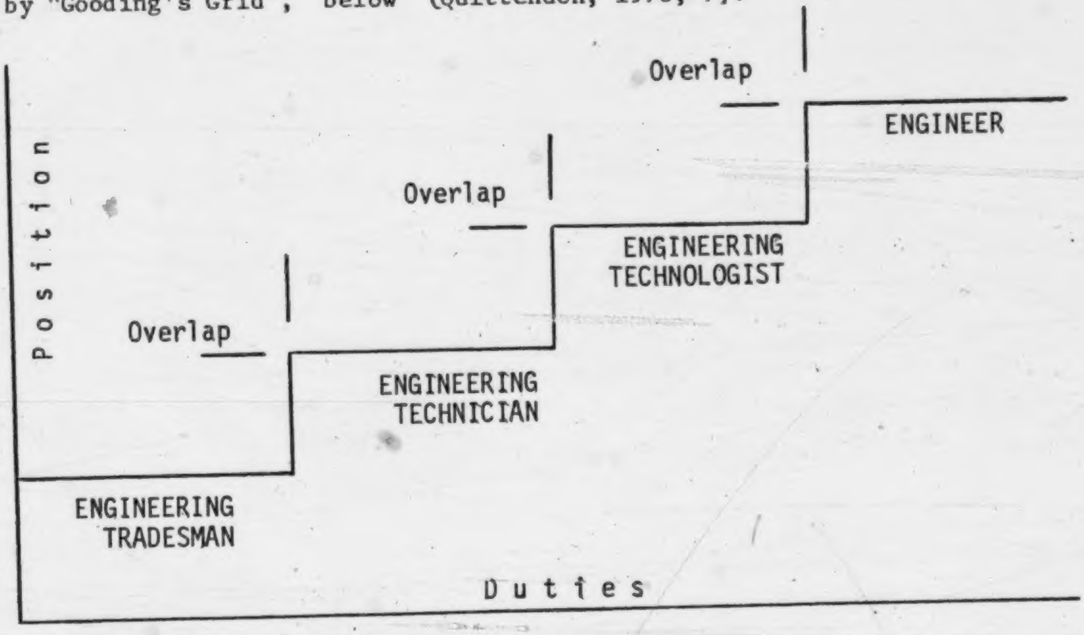
Position
Overlap
Overlap
Overlap
ENGINEER
ENGINEERING TECHNOLOGIST
ENGINEERING TECHNICIAN
ENGINEERING TRADESMAN
Duties

FIGURE 1.1

Figure 1.1 illustrates that the engineering tradesman is placed at the lowest step. Unlike the traditional trades, requiring an apprenticeship of three to four years, the draftsman (the corresponding title in the field with which this study is concerned) has usually obtained his training on the job, possibly supplemented by a number of short courses. The *Dictionary of Occupational Titles* (U. S. Dept. of Labor, 1965, v. 1) defines a draftsman's functions as follows:

> *. . . prepares clear, complete, and accurate working plans and detail drawings from rough or detailed sketches or notes for engineering or manufacturing purposes, according to specified dimensions: Makes final sketch of proposed drawing, checking dimensions of parts, materials to be used, relation of one part to another, and relation of various parts to whole structure. Makes any adjustments necessary or desired. Inks in all lines and letters on pencil drawings as required. Exercises manual skill in manipulation of triangle, T-square, and other drafting tools. Lays tracing paper on drawing and traces drawing in ink. Draws charts for representation of statistical data. Draws finished designs from sketches. Utilizes knowledge of various machines, engineering practices, mathematics, building materials, and other physical sciences to complete drawings.*

This description fails to describe accurately a graduate from Engineering Design and Drafting Technology; only the knowledges dealt with in the last sentence are expected from the technician and technologist levels, while the skills described, although part and parcel of his educative process, form only one part of the instruction of a technologist.

The same source has this to say about the technician (technical aid or technical [illegible]ssistant):

> *. . . a term applied to a worker who works in direct support of engineers or scientists, utilizing theoretical knowledge of fundamental scientific, engineering, methematical, or draft design principles. Solves practical problems encountered in fields of specialization . . . May specialize in working with Engineers and be designated Engineering Aid.*

The *Canadian Classification and Dictionary of Occupations* (Canada Manpower and Immigration, 1971, v. 1), in its description of work performed by draftsmen, suggests the following activities:

> *. . . preparing working plans and detailed drawings from designers' sketches and specifications for engineering and manufacturing purposes, preparing or revising maps or charts, and preparing illustrations dealing with assembly, installation, operation, maintenance and repair of equipment. Worker functions include: working to close tolerances to produce detailed drawings of a high standard, while skilfully manipulating draughting instruments and other technical equipment; computing mathematical details and determining scaled dimensions for drawings; and analyzing and compiling information from preliminary sketches and relevant data. Work activities include: advising on problems of interpretation of drawings for production personnel; determining suitability of design, materials, tooling and fabrication sequences, utilizing knowledge of manufacturing methods; preparing bills of materials and estimating costs; and tracing plans and drawings prepared by other draughtsmen.*

In the accompanying list of occupational titles (Chapter 2163) eighteen specializations on the technician level, and one on the tradesman's level are named.

In Chapter 2165, another fifteen technician-level and thirteen technologist-level occupations are listed. They are, however, descriptive of engineering and architectural specializations and do not include a generalist "Design and Drafting Technologist". Yet, the description of work performed calls for the services of a Design and Drafting Technologist, as evidenced by the underlined portions of the following quotation:

> *ARCHITECTURAL AND ENGINEERING TECHNOLOGISTS AND TECHNICIANS:*
>
> *. . . concerned with technological and technical work in an engineering specialization, such as aerospace, chemical, civil, electrical, electronic, industrial, mechanical, mining, nuclear, petroleum, metallurgical and petrochemical engineering, or in architecture. Worker functions include: examining and evaluating data obtained from engineering studies and experiments; collating and classifying information for use by engineers and other technical workers; testing and analyzing materials and products by qualitative and*

> *quantitative analyses; and skilfully using and controlling technical equipment and tools to produce items, such as accurate scale drawings, fabricate one-of-a-kind components and calibrate equipment. Work activities include: assisting engineers and other technical workers in research, design and development of products, and to devise systems and processes for production; constructing, installing, manufacturing, repairing, calibrating or modifying standard equipment or systems; incorporating design details into drawings; determining work procedures; diagnosing complex test equipment or process malfunctions; and preparing charts, graphs and other supporting data for reports.*

A comparison of educational prerequisites, such as required for certification with The Alberta Society of Engineering Technologists will better differentiate between the two levels of technician and technologist: a technician may be certified as such if he holds a high school diploma or equivalent, can show 100 hours of acceptable technology courses beyond the high school diploma level, four years of approved technical experience, and bears letters of reference. The grade of senior technician, unique to that society, stipulates one year of technical education at an Institute of Technology, while holding all other prerequisites equal. In contrast, certification as technologist is granted after a minimum of two years at a recognized Institute of Technology leading to a diploma of technology or equivalent. (A.S.E.T., 1974, 3-4)

In addition, the following may be offered to further clarify the distinction between a technician and a technologist: "A worker classified as technologist has successfully completed two or more years of study beyond high school at a recognized Institute of Technology, has thus acquired knowledge of scientific, engineering, mathematical, or design principles in more depth than the technician, and is more likely to assume positions of supervision and management than other members of the engineering team, with the exception of the professional engineer."

However, since no young graduate can be expected to begin his career in a managerial position, and also because his inclination led him to pursue a technical/applied scientific education, he is primarily destined to bridge the gap between theory and practice. Thus, in the words of the *Final Report* of the Engineering Technology Education Study (American Society for Engineering Education, 1972, 14), the central objective of engineering technology education has been found

> . . . *to be support for the practical side of engineering achievement with emphasis upon the end product rather than the conceptual process. There are many overlapping areas but, in broad outline, the engineering technologist may be said to help achieve what the engineer conceives. . . In contrast to engineering education where capacity to design is the central objective, engineering technology education develops capacity to achieve a practical result based upon an engineering concept or design either through direct assistance to an engineer, in supervision of technically productive personnel, or in other ways.*

In summary, the Engineering Design and Drafting Technologist introduced in this preamble, has, in the course of a two-year post-secondary program, received instruction in breadth as well as in depth in a technical specialty and its related academic disciplines, along with intensive skill development, with the aim of being enabled to perform successfully as an engineer's right-hand man.

STATEMENT OF THE PROBLEM

The problem, development of a relevant curriculum for any discipline, exists within the ongoing process of curriculum design and revision. At N.A.I.T., curriculum development is the responsibility of the instructional staff assigned to each technology, with regular input received from the members of the advisory committee. This latter input is somewhat limited, inasmuch as only one meeting of approcimately four hours duration is held in any given calendar year, and that there is little communication between the industry based members and N.A.I.T.

staff in the interval between annual meetings.

This type of industrial advice is somewhat augmented by attendance of the program head of Engineering Design and Drafting Technology at N.A.I.T. at the advisory committee meetings of the sister institution: Engineering Drafting Technology, Southern Alberta Institute of Technology (S.A.I.T.) at Calgary, Alberta.

The main responsibility for updating the curriculum of any given program at N.A.I.T. rests with the program head, while the line instructor is responsible for his subject matter. The experience of the writer suggests that the instructors in this technology show professional dedication and at all times endeavour to keep abreast of new developments. However, conversations with his colleagues have shown this writer that there is concensus among them holding that only full-time industrial involvement can offer complete and up-to-date knowledge of industrial practices. Most of the staff of Engineering Design and Drafting Technology have been removed from active participation in industry for some time, some for as much as fourteen years, while newcomers to the teaching profession, with up-to-date knowledge of industrial practices, are understandably too involved with learning the intricacies of pedagogy and with copying established procedures, to effectively infuse their up-to-date industrial experience into the whole of the program.

It must be stated, however, that at N.A.I.T. there exists a mechanism of re-immersion of instructors on staff in their fields of expertise by granting, e.g., one year's leave of absence, termed industrial leave (as distinguished from educational leave) with the object of updating the instructors and, through them, up-dating instruction. This opportunity, however, is limited to a small percentage of staff in any given year, and may not be available for years to any of the eleven instructors in the technology investigated herein.

It follows then that it is advisable to use additional avenues to determine the applicability of the academic and vocational preparation of Engineering Design and Drafting Technologists by the curricular offering presently employed, so as to establish an empirical basis upon which more accurate decisions concerning changes in the curriculum can be made.

PURPOSE OF THE STUDY

To this writer's knowledge, no study has been conducted to date in the geographical area served by the Northern Alberta Institute of Technology to ascertain to what extent graduates from Engineering Design and Drafting Technology perceive subject matter covered during their years of study as being important to their daily job assignments.

It was, therefore, the purpose of this study to obtain graduates' perceptions of on-the-job applications of items of course content, and to identify desirable subject matter not covered by the curriculum at the present time.

Included in the investigation was the actual job assignment of the respondent, to show to what extent he or she is engaged in technologist level work, and to what extent in the skill aspects of the field, so as to better correlate their perceptions of relevance vs. irrelevance with the position attained and the functions performed.

The ultimate objective of the study has been to formulate recommendations for the revision and improvement of the curriculum. A secondary purpose of the present study is the validation of the technique used as a suitable research method in like situations.

SIGNIFICANCE OF THE STUDY

Over the past fourteen years, administrators of the Institute of Technology and educators of its Engineering Design and Drafting Technology (formerly termed Drafting Technology) have met periodically with representatives of industry serving on that technology's advisory committee to discuss the aims and objectives, curriculum content, and facilities and equipment required to train technologists in the field. These discussions have been based to a great extent upon subjective opinions regarding the curriculum and job requirements. Recommendations emerging from these meetings, together with decisions made by the instructional staff, have from time to time resulted in additions to, and deletions from the curriculum as it stood at that time. There is no doubt that the advisory committee members did responsibly speak to the needs of the industries they represented but it cannot be expected of the ten of them actively engaged in industry to be knowledgeable about the needs of all the branches of industry employing graduates of the program.

To maintain relevance of the curricular content of the very rapidly changing requirements of industry necessitates a systematic approach to the obtaining of factual information on as broad a basis as possible.

Therefore, it is suggested that follow-up studies be conducted at intervals as deemed advisable by future rates of technological change.

The significance of the present study lies in the establishment of an empirical-base upon which to determine the applicability of existent course offerings, as well as their shortcomings, so as to give direction to those engaged in curriculum design and revision. More specifically, the findings and recommendations of this study shall be transmitted to the presidents, and through them to the administrators and the program heads of the two Alberta Institutes of Technology,and shall also be made available to any other technological institutions outside Alberta who might be interested in receiving them, and to the Alberta Society of Engineering Technologists.

Recommendations arising from the study should contribute to the ongoing process of curricular revision, to better equip the graduates with up-to-date knowledge, and all knowledges and skills necessary to raise them above the level of tradesman to their intended status and professional activity of a technologist. Such revisions are primarily substantive in nature, rather than methodological, but will likely lead to decisions regarding change of time allotment, and change of pedagogical approach in transmitting certain knowledges and skills.

Most findings based on the Edmonton scene are expected to be applicable elsewhere where similar programs of instruction exist, and where similar conditions in industry prevail.

With regard to the research methods used in this study, the author believes to have made a modest contribution to the knowledge of their validity as a tool for review and revision of curricula.

As a significant by-product of this study, the interest shown by the staff of N.A.I.T. who co-operated in the study, in the problems faced by industry, was rewarded by co-operation with, and keen interest in the study on the part of the respondents and especially, their employers. Thus the efforts of the investigator helped to intensify the dialogue between those who give service and those who are served. (Results will be mailed to cooperating firms and agencies.)

LIMITATIONS OF THE STUDY

This study was limited to a survey of (1) graduates in supervisory positions, (2) graduates in non-supervisory positions, and (3) instructors at the Northern Alberta Institute of Technology.

The study was further limited to samples of graduates employed by Edmonton based private firms relying on drafting staffs (such as utility companies, consulting engineers, land surveyors, manufacturing plants, etc.) and governmental and civic departments, all known to be the principal employers of graduates from this program.

The study was also limited in the time of sampling and administration of the research instruments to the months of June, July and August, 1976. Although all instructors were part of this study, their small number is also a limitation.

POPULATION AND SAMPLE

The population of this study, which numbered 136, consisted of all graduates of this program at N.A.I.T. since 1965, to whom the results of this study may be generalizable. From the population a random sample of sixty (60) was drawn and contacted. Of these sixty, twenty were found to be supervisors, and forty were found to be working under supervision, hereinafter called "supervisees."

There was no limitation on the number of instructors participating in the study: all instructors in Engineering Design and Drafting Technology, plus one drafting instructor of the Related Subjects Department, numbering eleven, took part in this research.

CHAPTER 2
SURVEY OF RELATED LITERATURE

IDENTIFICATION AND TRAINING OF THE TECHNOLOGIST

Some literature concerning the technologist, as a specific member of the engineering team, has been cited in chapter 1. It is the purpose of this section of chapter 2 to review various other sources pertinent to the definition of the term technologist in general, and of the engineering design and drafting technologist in particular. Also, sources pertaining to training aspects are compared.

At times, especially in the earlier years of the past two decades, some confusion in semantics has existed, and often the terms "technician" and "technologist" have been used interchangeably. In some works, the authors use the term "technologist" in conjunction with associate degrees and baccalaureate degrees in engineering technology (American Society for Engineering Education, 1972, 4, 6-43), and different writers may mean different things by the same term, as expressed by the following statement (Ibid., 25):

> *As of now [1972] very little influence for standardization of names or designations of technical curricula, programs or degrees has occurred . . . The term engineering technology as a curriculum designation is also used for both two-year and four-year programs, a practice which will continue to be somewhat confusing.*

Speaking on the role of technicians in industry before the Chicago Association of Commerce and Industry, in 1965, Dr. Crewe, director, Argonne National Laboratory, and Mr. Gershon, dean of the Resident School, DeVry Technical Institute, are either using the term technician as that of technologist is understood in the Alberta setting, or are linking the term technology to associate degrees and transferability to baccalaureate programs. Dr. Crewe (Crewe, 1965, 5) stated,

> *[Ten years ago] in the life of the Laboratory . . . we took people with only a high school education and trained them here to be technicians. This was difficult for us to do, and fortunately in the meantime along came the technical institutes. They are probably doing the job much better than we can. They take the high school graduates and give them two years' additional training. We take them from that point. In fact, I believe that is the minimum educational level we now demand of all technicians we hire.*

The two years' post high school education spoken of by Dr. Crewe is comparable to a technology program at an Alberta Institute of Technology. At the same conference, Dean Gershon (Gershon, 1965, 3-4) cited from the 1962 report to the American Society for Engineering Education, entitled "Characteristics of Excellence in Engineering Technology Education":

> *Engineering technology is that part of the engineering field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational area between the craftsman and the engineer at the end of the area closest to the engineer.*
> *An engineering technology curriculum is a planned sequence of college-level courses, usually leading to an associate degree, designed to prepare students to work in the field of engineering technology.*
> *The term college-level in the definition of an engineering technology curriculum indicates the attitude with which the education is approached, the rigor, and the degree of achievement demanded, and not solely or even necessarily that the credits are transferable to baccalaureate programs.*

The last statement appears to back the position taken by advanced education in the Province of Alberta. Gershon (Ibid., 8) also remarked:

> *How do the courses in a technical institute differ from those in a college? Those in a college are intended to build a strong math and science core for graduate studies; those in the technical institute are application oriented. The books may be the same in many cases, but they are taught differently with the emphasis placed on different areas.*

A clear cut distinction between technologist and technician, and of more recent date, was made in The VRE Technical Education Newsletter of June, 1974 (Vishay, 1974, 4), which read in part:

> *. . . Engineering technology graduates are generally described as "technologists" to distinguish them from engineers on the one hand and technicians on the other. The technologists are looked upon as supportive of the engineering function and participative in that function at a more sophisticated level than technicians. The education of the technologist, while less rigorous and theoretically oriented than many current engineering curricula, is intended to provide him with a firm technical background for understanding the components and systems in his field of specialization (electrical, mechanical, civil, etc.). As commonly viewed, the technologist is expected to find his niche in such areas as manufacturing, design for production, quality control, technical selling, and systems operation.*

The writer here ascribes to the technologist a higher degree of sophistication in job function which ought to mean technical education in more depth than that achieved by the technician. Goodings et al., in their report to the Ministry of Colleges and Universities, Province of Ontario (Goodings, 1974, 118), have indicated that the importance of the role of technologists on the engineering teams in industry, even if not yet fully understood, is nevertheless acknowledged by the readiness with which graduates from Ontario institutes are employed. In an effort to identify the role of the engineering technologist, the researchers distinguish between technicians and technologists (Ibid., 74):

> *An engineering technician might direct a group whose function is the maintenance of complex process equipment but would normally be limited to a support role in a group whose function is the design and development of the same process equipment.*
> *An engineering technologist might be in charge of a group designing and developing production machinery which is an extension of, or improvement on the existing facilities. He would likely be engaged in a supportive role within a group creating the engineering concept of a completely new process.*

To better illustrate the identification, the authors present a matrix which not only assigns specific job functions to engineers, technologists and technicians, but does also, on closer inspection, point out the overlapping qualities inherent in their different roles (Ibid., 75):

TYPICAL ROLES OF THE ENGINEER, TECHNOLOGIST AND TECHNICIAN

		Classification		
		Professional Engineer	*Engineering Technologist*	*Engineering Technician*
Group Function	*Eng. Science or Innovative Engineering*	*Problem analysis* *Synthesis of solutions* *Direction of R & D* *Engineering concepts*	*Development of:* *models* *pilot plants* *prototypes* *Supervision of drafting*	*Testing* *Specifications* *Drafting*
	Engineering Practice	*Design of processes of systems* *Direction of:* *product design* *equipment design* *development* *Technical sales*	*Product design* *Equipment design* *Design of test equipment* *Development of test procedures* *Resolution of production problems* *Technical sales*	*Assist with:* *design* *development* *Supervise:* *testing* *specifications* *drafting*
	Engineering Technology	*Training and development* *Plant engineering* *Maintenance engineering* *Production engineering* *Application engineering* *Technical sales*	*Supervision of:* *design* *development* *maintenance* *production* *Production engineering* *Plant engineering* *Application engineering* *Technical sales*	*Time & motion study* *Production supervision* *Maintenance planning* *Supervise:* *testing* *specifications* *drafting* *Design calculations* *Selection of components*

TABLE 2.1

Future attempts at role definitions of members of the engineering team should take into account research findings such as the above, in an effort to eliminate the confusion which still exists. Elsewhere in their study, Goodings et al. have attributed some of the blame to the use of established job titles, tailored to various industrial hierarchies:

> *It [the denial of formal identification by technologists themselves] suggests . . . that there is confusion about the role of engineering technologists to the extent that publicly they are identifying themselves to a lesser degree through a little-known professional connotation and more so through an established job title which might convey a greater status in society, namely, manager, supervisor, inspector, 'engineer'.*
> *. . . the role of engineering technologist . . . is blurred even further by the improper use of titles by their employers; technologists are designated as technicians, technicians and technologists are designated as engineers and, on occasion, tradesmen are identified as technicians or even as professionals.*
>
> (Ibid., 76-77)

Briefly summarizing the literature reported on above, it has been shown that, since earlier years when the term technologist had been non-existent, through more recent periods of time when much confusion existed in the distinction between technicians and technologists, to the present when a more clear cut delineation of job functions on different levels of the engineering team, professional engineer - engineering technologist - engineering technician, appears to emerge. An attempt has been made to define the role of the engineering technologist generally, without regard to his field of engineering specialization.

To more closely identify the graduate from Engineering Design and Drafting Technology as an engineering technologist, the following is presented for consideration.

Early in 1971 the (then) Drafting Technology program at the Northern Alberta Institute of Technology, and the (then) Engineering Graphics program at the Southern Alberta Institue of Technology, were about to be excluded from the number of certifiable technologies. Graduates from these programs were much concerned, and their fears were not unfounded because at that time the Alberta Society of Engineering Technologists yielded to a pronouncement by CCETT (Canadian Council of Engineering Technicians and Technologists, the national coordinating body of Canada) who adopted the position of OACETT (Ontario Association of Certified Engineering Technicians and Technologists), and, temporarily, certified graduates as "Senior Technicians". This position was to disallow Drafting as a technology, as compared with Mechanical, Structural, Civil, Electrical, etc., technologies, on the grounds that, in their belief, only those programs can be accredited which have a relatively high engineering technology content as opposed to a pure skill content. The action by the Alberta society's certification board then culminated in setting policy (Ozubko, April 23, 1971), and reaffirming that policy (Ozubko, June 11, 1971), to certify drafting graduates (following two years of work experience) as senior technicians, and to upgrade them to technologist status only after having taken two additional subjects, in depth, in the area in which they are working, and have worked in that area for a minimum period of three years.

This ruling produced a backlash in the form that very few graduates sought certification at all, a fact that is corroborated by one of the findings of this study (only 9 out of the sample of 60 are members of their professional association as of the summer of 1976).

General discontent, as well as submissions by the educators concerned of the Alberta Institutes of Technology resulted in the appointment of a committee of professional engineers who submitted their report on drafting technology certification to the Certification Board (Sorensen, 1974) in February, 1974, whereupon a special meeting of the board after extensive deliberation, unanimously passed the motion:

> *The graduate in drafting technology from the Northern Alberta Institute of Technology, the Southern Alberta Institute of Technology, or their equivalents, be certified with the classification of technologist, all other qualifications having [been] satisfied and that such recognition be accorded retroactively to those members in good standing.* (Puffer, 1974, 4)

This policy, now in effect, was based on the following conclusions:

> (a) *There are equivalent pre-requisites for students to enter all technologies at NAIT or SAIT.*
>
> (b) *The mathematics content of the drafting program is in the middle range of all technologies.*
>
> (c) *There is a high level of acceptability for drafting technologists.*
>
> (d) *In Europe, the trend is to train drafting technology students as "generalists".*
>
> (e) *There is the need for the drafting technologist to be capable of advancement within the Engineering Team.*
>
> (f) *Up-grading, if required, is readily available.*
>
> (g) *In the main, drafting had been removed from University courses leading to an engineering degree.*
>
> (Puffer, 1974, 3)

At the same meeting of the board, on March 13, 1974, it was also suggested that the word "Drafting", leading to so much confusion, was a misnomer, and it was urged that immediate consideration be given to a more descriptive title, which eventually led to re-naming Drafting Technology at the Northern Alberta Institute of Technology to Engineering Design and Drafting Technology, a term which more adequately represents the emphasis on the design aspects of the program.

An identification of the technologist would not be complete if no consideration were given to the question whether or not the educational institution is preparing the student in a manner optimal for his own future success, and of service to industry and the community at large. In this context, Brubacher (Brubacher, 1968, 394-395) states:

> *There seems little doubt that American colleges have realized their ideals of service. They have never been isolated "ivory towers" but, rather, high "watch-towers." They have furnished the professional training needed by a growing nation. They have contributed to the efficiency of its economy by making possible the specialization required by a technological age. . .*

This brings to the fore the apparent contrast between a specialized, and a more general training program. Among the advocates of the specialized curriculum, Roney has made a case for organizing programs so as to prepare students for specific job tasks (Roney, 1965). Harris, on the other hand, favored a core curriculum, common to several technologies, for a basic level of attainment in general education, science and mathematics, and supporting technical courses to assure employers of employees with potential for future growth (Harris, 1965, 72).

Although "design and drafting" may, at first glance, be regarded as a specialty within the engineering field, the diversification of branches of engineering necessitates a like diversification of corresponding design and drafting personnel. To prepare students to enter any of these fields or branches, and, if the occasion arises, to move from one to another in the course of their careers, still able to function successfully in the field, it has been the policy of the Alberta Institutes to offer common core subjects along with courses ascribed to fields of specialization. This is evident from an information poster prepared by the writer earlier in 1976:

NAIT Engineering Design and Drafting Technology
Offered at Northern Alberta Institute of Technology
Credential awarded: NAIT Diploma.
Duration: Two years - September to May. . .
Specific Admission Requirements:

Alberta High School diploma or equivalent with 50% or better in XII Math 30, 32, 33 or 36 and credit in a XII science subject: physics (preferred) or chemistry or biology. Applicants having credit in Drafting 32 may be granted exemption for basic drafting.

Opportunities:

Graduates, both male and female, become technical assistants to professional engineers, architects, surveyors, planners or manufacturers, and find good opportunities for advancement in federal, provincial and civic engineering offices as well as in private industry. On the job work includes drafting, design, calculations, preparing reports, and supervision in such varied fields as architecture, structural, mechanical, municipal, electrical-electronic engineering, surveying, mapping or town planning.

Graduates are eligible for certification as Technologists with the Alberta Society of Engineering Technologists after two years of suitable experience.

Description (First Year):

Course areas include mechanical design and drafting, descriptive geometry, architectural and structural design and drafting, topographic drafting, surveying, effective communications, materials of construction, properties and strength of materials, heat and electricity, and machine shop.

Description (Second Year):

Course areas include mechanical and machine design and drafting, architectural and structural design and drafting, specifications and contracts, electrical and electronic design and drafting, heating, ventilating and air conditioning, hydraulics, municipal design and drafting, survey drafting, geological drafting, aerial photo interpretation, technical illustration, and options in the structural, electrical, mechanical and town planning fields.

(Northern Alberta Institute of Technology, 1976)

A more detailed overview of the program, by year, quarter (= trimester) and course designation, is shown in Appendix C, page 86, translated for the purposes of this study into pie charts, Figure 2.1, page 21.

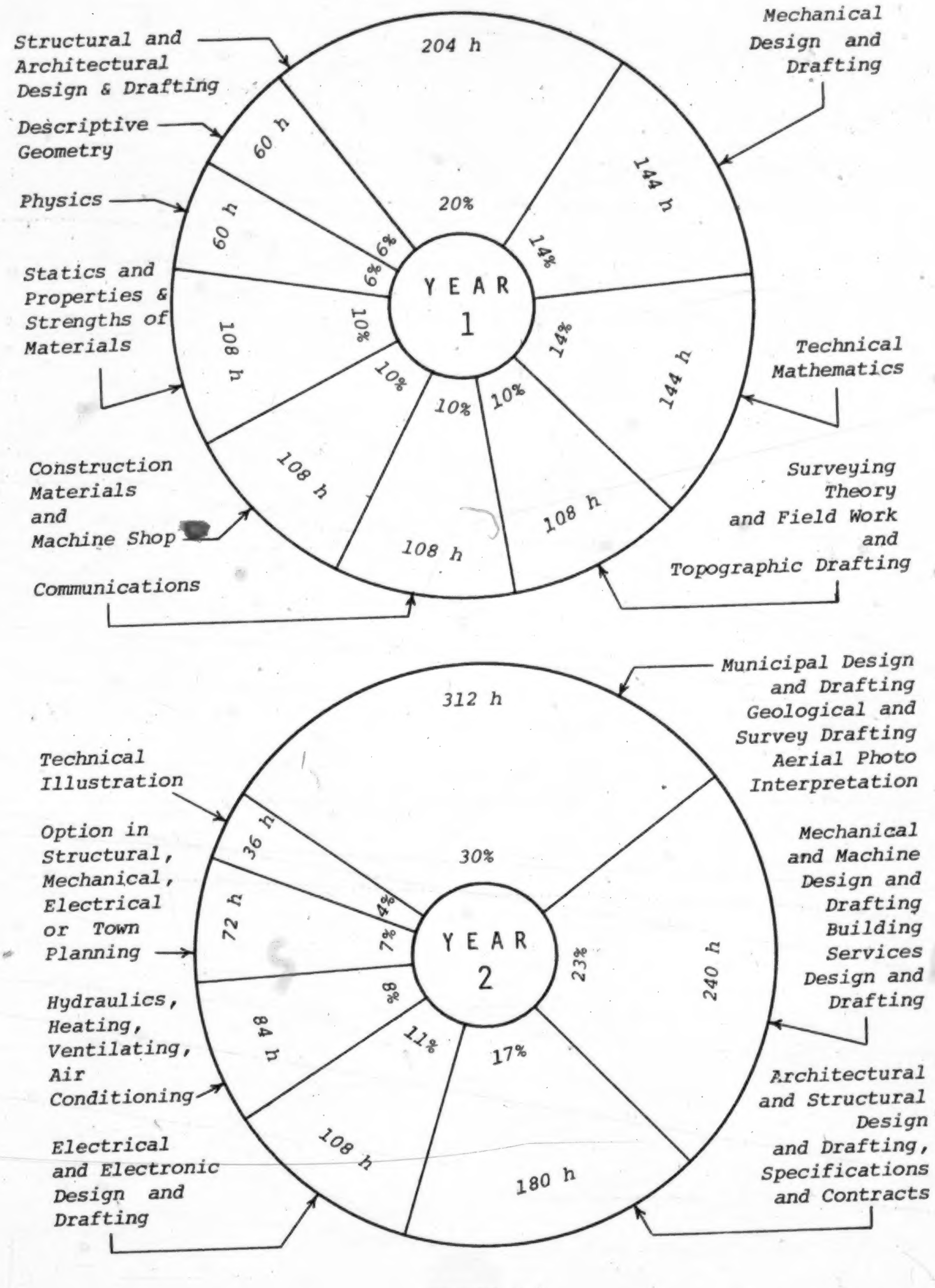
Structural and Architectural Design & Drafting
204 h
20%
Mechanical Design and Drafting
144 h
14%
Descriptive Geometry
60 h
6%
Physics
60 h
6%
YEAR 1
Statics and Properties & Strengths of Materials
108 h
10%
Technical Mathematics
144 h
14%
Construction Materials and Machine Shop
108 h
10%
Communications
108 h
10%
Surveying Theory and Field Work and Topographic Drafting
108 h
10%
Municipal Design and Drafting Geological and Survey Drafting Aerial Photo Interpretation
312 h
30%
Technical Illustration
36 h
4%
Option in Structural, Mechanical, Electrical or Town Planning
72 h
7%
YEAR 2
Mechanical and Machine Design and Drafting Building Services Design and Drafting
240 h
23%
Hydraulics, Heating, Ventilating, Air Conditioning
84 h
8%
Electrical and Electronic Design and Drafting
108 h
11%
Architectural and Structural Design and Drafting, Specifications and Contracts
180 h
17%

FIGURE 2.1

THE NEED FOR CURRICULUM STUDIES

Experience dictates that any enterprise, to be successful, must obtain maximum feedback on its results, that is, not only to keep communication lines open but to make a systematic effort to optimize communication in both directions: input and output. Decision making, in the case of this study regarding curricular changes, must depend on unobstructed information flow, and the establishment of a decision centre. In this context, Simon et al. (Simon, Smithburg and Thompson, 1950, 219-220) have stated:

> *Viewing the communication process from a point in an organization where a decision is to be made, the process has a twofold aspect: communications must flow to the decision center to provide the basis for decision, and the decision must be communicated from the decision center in order to influence other members of the organization whose cooperation must be secured to carry out the decision.*

In the area of curricular decision making, both internal and external communications are essential. The former pertains to intra-institutional information flow, the latter to communications between the teaching institution on the one hand, and industry and the community on the other. Harlacher (Harlacher, 1969, 43) has expressed this thus:

> . . . *Within the college, it is necessary that channels of communication* . . . *be clear cut, so that confusion and duplication of effort can be avoided. Outside the college, it is essential that a wide variety of media be used to reach all segments of the college district community. Internal communications can be regulated and strengthened at their source; it is the effectiveness of external communications that is of vital importance to the growth of the entire college, both in stature and in service.*

One medium, of the "wide variety of media" mentioned by Harlacher, and employed in the present study, is that facet of communication which elicits feed-back on curriculum content from graduates of the program. It is shown, together with internal channels, as input obtained from a pool of graduates, in Figure 2.2 below:

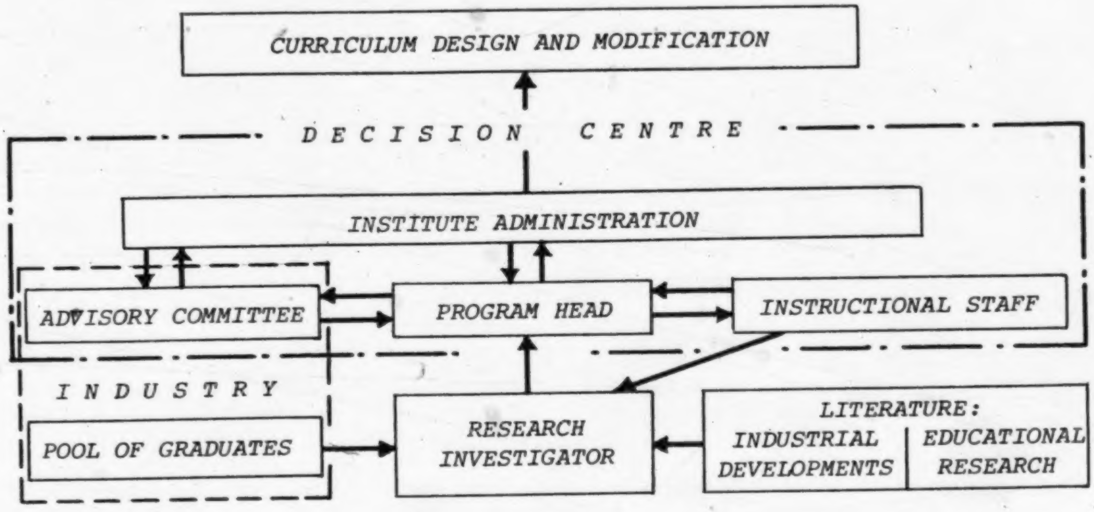
CURRICULUM DESIGN AND MODIFICATION
DECISION CENTRE
INSTITUTE ADMINISTRATION
ADVISORY COMMITTEE
PROGRAM HEAD
INSTRUCTIONAL STAFF
INDUSTRY
POOL OF GRADUATES
RESEARCH INVESTIGATOR
LITERATURE:
INDUSTRIAL DEVELOPMENTS
EDUCATIONAL RESEARCH

FIGURE 2.2

COMMUNICATION LOOP

As is evident from the figure above, curriculum-relevant information elicited in this study, can be traced from the graduates through the investigator and the program head to the advisory committee and institute administration. The loop is closed when the flow continues back to the program head and his instructional staff. It is also suggested herein that the decision centre responsible for curriculum design and modification encompasses not one, but four entities whose work, in co-operation, will culminate in decision making.

The need for a functional approach to curriculum design, by involving all sources capable of making contributions, such as administrators, educators, advisory committee members, employers, supervisors, and workers, was also recognized by Kamra who stated:

> . . . *It would appear logical that the technicians who are employed within a given occupational field, should as a total group be in a position to exercise reasonable judg-*

> *ments concerning the necessary elements of the subcurriculum for the training program.*
>
> *The immediate professional-level supervisors . . . should also . . . be able to exercise reasonable judgments concerning the elements of training curriculum necessary for generalizability of training, within their individual operations.*
>
> *. . . An expectation the college has from the advisory committee members is that they advise the college concerning the innovative trends in the particular occupational field. . .*
>
> *. . . The instructors teaching in a given occupational curriculum should be able to identify the needed elements of training considered to be necessary by the industry information groups (advisory members, supervisors, and technicians). To these elements they may add their own inputs, perceived by them to be of importance in individualizing instruction and exercising individual expertise.*
>
> (Kamra, 1971, 63-64)

Schill and Arnold, who conducted an exhaustive curriculum study for six technologies, have concluded that

> *. . . As education more adequately fulfills its function, it in itself changes industry, thus compounding previous changes. Therefore, it is assumed . . . that providing more precisely for the educational needs of the technician may have a desirable role in forthcoming innovations in industry.*
>
> (Schill and Arnold, 1965, 4)

They also have given due consideration to a number of logical sources for curriculum-relevant input, as apparent from the following remarks:

> *Use of [technically oriented] kinds of management personnel assures the study of respondents who are qualified to assess the relationship of curricular choices to the job functions of the technicians. . .*
>
> *Various groups and individuals have been assumed to have legitimate concern for and understanding of curricular problems for the different areas of education. Three of the groups which logically present themselves as parties concerned with the education of technicians are (1) the technicians themselves, (2) the pedagogical, engineering, and other participating staffs of universities and colleges, and (3) the companies employing the technicians, or more specifically, technically qualified management*

> *personnel of these companies.*
>
> *The translation of required skills and abilities into a curriculum becomes a subjective matter in most cases. . . The problem at hand is to establish an empirical basis on which more accurate decisions concerning curriculum content in technical education can be made prior to the institution of training programs.*
>
> (Ibid., 8-9)

Catalanello and Kirkpatrick reported in the Training and Development Journal on a research study in the area of trainee job performance as related to their educational experiences, and found that a vacuum existed in the field of research studies concerned with determining and analyzing current techniques used by business, industry, and government in the evaluation of their training programs. They concluded that methods to evaluate training programs are still in their infancy.

(Catalanello et al., 1968)

Rowlett, concerned with "Combatting obsolescence in drafting instruction", suggested a new approach to closing the gap between drafting instruction and the practice of drafting in industry, involving closer cooperation between educational institutions and industry. By assessing existing educational practice in drafting, he showed that a significant gap existed between the character and nature of drafting instruction and the way in which it is practised in industry. Pointing to the need for research and experimentation in teaching technique and curricula, Rowlett suggested that a more active partnership be formed between teacher training institutions and the drafting rooms of industry.

(Rowlett, 1967)

From the literature surveyed it has been found that research done in the area of engineering design and drafting, to date, was largely of general scope, such as reported by Lipsack (Lipsack, 1968) who, as a result of his study, did not go beyond listing job descriptions and qualifications for five levels, i.e., tracer/beginner, detailer, layout artist, checker, and design draftsman (excluding the first mentioned, approximately comparable with the levels of certification of - drafting - technician, senior technician, technologist, senior technologist), and predicting that the increasing application of improved draft assisting devices will make beginning level draftsmen less profitable, perhaps unnnecessary.

Much more specific research is needed, and it is evident from the foregoing that to keep an existing technology program viable, up-to-date, and answering the requirements of industry and of the technologists themselves, periodic studies are required which will provide input to the educational institutions from the exterior sources concerned.

METHODS OF PAST RESEARCH

As previously stated, no in depth follow-up studies of engineering design and drafting technology graduates could be identified in the literature available to this investigator (sources at the University of Alberta and the Northern Alberta Institute of Technology). However, it was found that some studies done in other fields were valuable in providing guidance to the present study. It will be shown in this section of the chapter how some of these studies used methods of data collection different from those applied by this researcher, while others suggested a probably superior method of elicitation of the responses sought.

In 1965, Werner Steinbach (Steinbach, 1965) initiated a research project with the objective of reorganizing a three-year technical college course for higher technicians (Ingenieur-Schule) by ascertaining how to raise the standard of instruction without prolonging the training period. The procedure employed involved 25 experimental classes (725 students) and 20 control classes (568 students). A whole series of new ideas was to be tried out in the experimental classes: more precise and detailed curricula, regrouping of subjects, more thorough instruction in basic subjects, extensive use of audio-visual aids, programmed instruction, increasing the length of each semester, and decreasing the weekly number of lessons so as to increase the time available for individual study. At the same time, instruction was to be given according to the usual syllabi and methods in the control classes. Aside from using experimental and control classes during the period of instruction, employers were to be surveyed six to twelve months after the appointment of a young higher technician (= technologist), to ascertain his immediate supervisor's assessment of his qualifications. These data were to be used in determining future curricular decision making. Steinbach's approach clearly belongs with experimental research, and may constitute a very worth-while strategy in circumstances permitting comparisons over a long period of time (four years as in the case of that study).

A study aimed at obtaining responses relevant to secretarial skills, indirectly following up on graduates from the Northern Alberta Institute of Technology, was carried out by Mrs. O'neil (O'neil, 1968). The survey by questionnaire was limited to employers; no attempt was made to gauge the opinions of the graduates themselves, and the research design with the results, reported on 18 pages, lacked the sophistication normally expected from such a project. It was decided, therefore, by this investigator, not to use that study as a model.

Among follow-up studies of technology graduates is that of graduates of gas technology, conducted by Horace Ottley (Ottley, 1973; Bryce and Ottley, 1973). In that case the researcher chose to use a questionnaire for data collection over the method of conducting structured interviews because the latter method is " . . . *extremely time consuming and the researcher may have to be content with a relatively small sample of his population*" (Bryce and Ottley, 1973, 25). Yet the authors concede that mailed questionnaires are getting exceedingly more unpopular with those who are becoming increasingly exposed to them. To obtain results for that particular study, Mr. Ottley was, indeed, forced to resort to several reminders (Ibid., 10, 34-35), eventually yielding responses from 75 percent of the graduates and 85 percent of the supervisors (Ibid, 27). Although these percentages may be deemed quite acceptable, it was only after direct communication with the respondents by an undisclosed number of telephone calls and personal visits to the companies concerned (Ibid., 26) that the researcher could obtain the data he needed.

For the purposes of his research, this writer has decided against the mailed questionnaire as the principal research instrument. In a previous study done by him in the winter of 1975/76, to obtain industry responses regarding a new, planned curriculum for mapping technologists, he too found that appeals by mail often go unheeded until a more personal contact is made.

A study done in Ontario (Summers, 1969) had as its purpose the establishment of an empirical basis upon which to evaluate the relatedness of an existing drafting curriculum to present industrial trends, so as to isolate course content to be retained or discarded, and to establish the areas where emphasis should be placed. (The curriculum in question was not engineering design and drafting technology, but a high school vocational education course.) A questionnaire was used, the first part of which was concerned with present course content used by undefined technical schools in Ontario. Knowledges and operational skills were classified under two headings: importance (very-quite-fairly-little or no) and use (constantly-frequently-infrequently-never). The second part of the instrument elicited information on type of drafting done; main catalogues and manuals referred to; and various personal data and career perceptions. Part I of the questionnaire yielded opinion data on the importance and frequency of 42 knowledge areas or skills and techniques. The report did not show statistical analysis of data. Part II corroborated the assumption that "mechanical draftsmen" specialize in a great variety of engineering fields, and identified these areas. Among his conclusions, the investigator stated that, generally, not enough liaison exists between industry and educational institutions, and urged that this situation be rectified in the interest of useful and worthwhile education. Mr. Summers did not comment on the difficulties encountered with questionnaire-type data collection.

This investigator then turned to studies utilizing the Q-sort technique or an adaptation of the same. The importance of technique per se has been emphasized by Haines (Haines, 1966, 44) who stated:

> *Occupational analysis should be used more frequently than it has been, but considerable emphasis needs to be placed upon the refinement of procedures . . . Increased use and refinement of usable techniques are a prime need if training . . . is to meet the current challenges.*

In reporting on the Q-sort technique for group measures, Morsh (Morsh, 1955, 390-395) proposed a method of placing test items on separate cards, to be sorted by the respondent into a specified number of stacks, according to his opinion, and only a specified number of cards was to be placed in each stack so as to conform to a normal curve. The relationship between any two stacks could then be determined in terms of a correlation coefficient.

This, the original type of a Q-sort, or forced sort, was found not fully applicable in group use when applied to curricular research, by Schill (Schill, 1966, 19-20) who stated that, since it could not be assumed that all respondents to a curriculum study had equal knowledge of all card content, normal distribution was not applicable, and that an unforced sort (= no specified number of cards per stack) was preferable in that case due to its ease of analysis.

The same author (Schill, 1961, 178-184) had previously used the unforced sort for determining curriculum content in a study of electronics technicians in California industries, when through the use of Kendall's coefficient of concordance it was shown that technicians agreed at the 1 percent level in their sortings.

Perhaps the most extensive of that researcher's studies, aimed at isolating a common core curriculum for six technologies, and employing a modified version of the Q-sort, was carried out in collaboration with Arnold (Schill and Arnold, 1965). Again the unforced sort was used because one group of cards was totally unrelated to the knowledges of all respondents. Therefore, the normal distribution was not possible to obtain meaningful responses from the respondents.

In describing the general methodology of the study, the authors stated (Ibid., 9-10):

> *One of the basic concerns of the project was to be as representative of the industries and their personnel as possible within the monetary and time limits of this study. To give representation, it was necessary to have randomly-selected technicians from randomly-selected industries. It was reasoned that many supervisory personnel are in key positions to know what industry needs and desires in technical competencies, assuming that these supervisory personnel are hired or promoted on the basis of capability to understand broader relationships and on knowledge of and concern for industry-wide and company objectives. . .*

Petruk (Petruk, 1967) also used a modified card sort for the purpose of assessing technical qualifications. In that study an experimental group and a control group were used, and between-groups and within-groups analyses were performed.

Hovis (Hovis, 1969) used both questionnaire and card sort for the purpose of determining an empirical basis upon which more accurate decisions concerning the preparation of recreation personnel could be made in establishing and revising programs for recreation education. Of 481 full-time professionals working in seven large Western U. S. municipal recreation departments, 359 received a survey questionnaire which was completed by 295 respondents. The questionnaire invited information on personal history, professional activity, and promotional considerations. In personal follow-up interviews, 79 of these completed a card sort of 117 items, consisting of course descriptions covering a wide range of academic content, designed to determine what skills and knowledges were deemed most important in performing different functions. From the study emerged the identification of a number of factors related to curriculum design, such as a necessary core curriculum, specialized curricula for supervision and leadership, and for administration, and the timing in transmitting skills and knowledges. The card sort technique utilized in this study was found to be an instrument well chosen for the purpose, and said to provide a tool with which to review curricular needs on an ongoing and systematic basis. Moreover, Hovis found significant differences between the admininistrators' and the supervisors' and leaders' responses to almost one-third of the sort cards tested, thereby providing evidence that the card sort technique was a potentially useful method in comparing group responses, one with another.

In a study whose objective was to develop a model for testing curriculum-relevant information flow to a decision centre, Kamra (Kamra 1971), in testing the model, derived measurements by the application of an unforced card sort containing 168 cards listing curricular items of one specific technology (chemical technology at the Northern Alberta Institute of Technology), administered to 14 advisory committee members, 14 supervisors, and 39 technicians, as well as to 15 instructors in chemical technology. Kamra, also, found the modified Q-sort technique a useful tool for the elicitation of curriculum-relevant opinions.

Another study conducted at the Northern Alberta Institute of Technology, utilizing an unforced sort of 190 cards, each with an occupational behaviour listed, was conducted by J. A. Want and other members of the curriculum evaluation sub-committee on Telecommunications Technology (Want, 1974). This card sort was completed by technicians and their immediate supervisors, by advisors and technology instructors. It was found that the technicians had judged 77 of the 190 items, i.e., 40.5 percent, as presently not required on the job. A list of these rejected items was then presented to the advisory committee of that technology for consideration. It was, however, also established that the immediate supervisors felt that their technicians actually required an even narrower set of skills than the men said they required.

SUMMARY OF PAST RESEARCH

Comprehensive studies conducted over a prolonged period of time, such as that by Steinbach (p. 27), are desirable because the validity of their results has been time-tested. It may not always be possible for an individual institute to undertake research on that scale, or it may be seeking more readily available answers.

Research, utilizing mailed questionnaires, of the varying types used by O'neil, Ottley, and Summers (pp. 27-29), has shown built-in weaknesses, especially in the phase of data collection.

The forced type of Q-sort method of Morsh (p. 30) is not designed for use with curriculum validation studies, whereas the unforced type, pioneered by Schill, and again used by Schill and Arnold (pp. 30-31) was also found useful in studies undertaken by Petruk, Hovis (p. 31), Kamra, and Want (p. 32).

Research methodology directed at obtaining valid and reliable data based on the perceptions of curriculum content by practitioners in the field, has been shown to be well served by a modified, unforced Q-sort technique. It was, therefore, that this investigator chose to use that method for the principal instrument in his own study.

CHAPTER 3

METHODOLOGY

GENERAL

This chapter describes the research methodology used in this study, and includes descriptions of the design, the instrumentation employed, revisions and the pilot study, assumptions and hypotheses, the population and sample selection, the collection of data and data analysis.

DESIGN OF THE STUDY

The sequential pattern of the research activities connected with this study followed a modified version of Wiersma's paradigm, as illustrated hereunder:

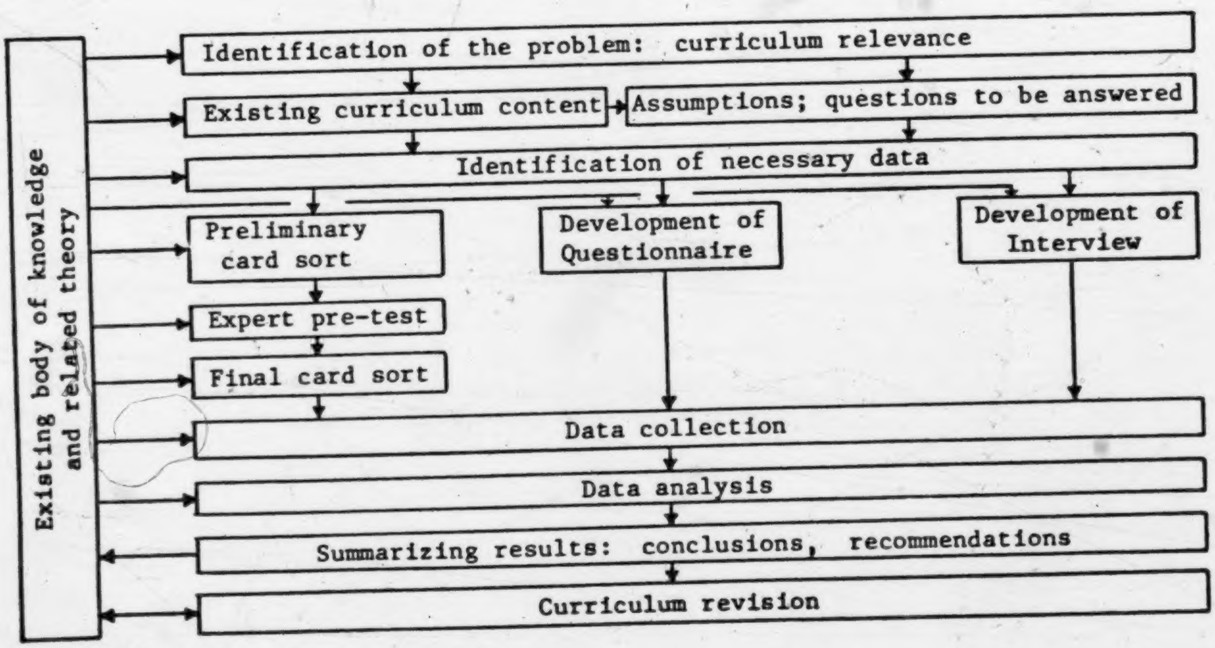
Existing body of knowledge and related theory
Identification of the problem: curriculum relevance
Existing curriculum content
Assumptions; questions to be answered
Identification of necessary data
Preliminary card sort
Development of Questionnaire
Development of Interview
Expert pre-test
Final card sort
Data collection
Data analysis
Summarizing results: conclusions, recommendations
Curriculum revision

FIGURE 3.1

INSTRUMENTATION

The data used in this study were obtained through the use of three instruments, viz.,

(1) an unforced, modified Q-sort, as described in Chapter 2, pp. 29 to 33 herein, a copy of which appears in . . . . APPENDIX D

(2) a brief questionnaire for the purpose of correlating judgments derived from the card sort with personal and employment data of the respondents, as shown in . . . . APPENDIX E

(3) a focused interview designed to elicit additional perceptions of desirable but absent curriculum content, and to provide information on professional membership status, promotional opportunities, and supervisory and/or drafting activities . . . . . . APPENDIX F

Of these three instruments, the modified Q-sort represented the principal one. Four identical decks of cards were prepared to allow simultaneous administration of the same to up to four respondents. A deck of cards consisted of 278 curriculum items, representing a wide range of knowledges and skills taken from the course outlines of the two-year Engineering Design and Drafting Technology program at N.A.I.T., with some additional items derived from the calendar descriptions of the equivalent program of the Southern Alberta Institute of Technology, and, with respect to cartography, of Algonquin College.

REVISION OF THE CARD SORT AND PILOT STUDY

The card sort, originally numbering 271 items, was submitted to a panel of experts composed of 5 drafting instructors at N.A.I.T. Using a comment form (Appendix G), the experts either approved of items, remarking "leave as is", or suggested changes or deletions. All of these changes were included in the revised version of this instrument.

It was anticipated that following the scrutiny by the experts the number of card items would decrease. It was found, however, that the opposite occurred, resulting in 278 cards for the final sort.

As an ultimate step leading to possible revision of card content and methodology, a pilot study was undertaken in the spring of 1976, when the sort was administered to ten instructors of Engineering Design and Drafting and one instructor of Related Subjects at N.A.I.T. In analyzing the results of the pilot sort, it was found that the instrument could be used unchanged with the sample to elicit the data sought by this study.

ASSUMPTIONS AND HYPOTHESES

The following assumptions were made relative to this study:

1. The opinions expressed by the supervisory group of graduates would be the most valid measure of the relative importance of the skills and knowledges required for successful employment.
2. The card sorts of the instructors would be a valid reflection of the relative importance they place on the skills and knowledges in this study when preparing students for engineering design and drafting careers.

3. Graduates are familiar with, and will correctly interpret the meaning of all card statements.
4. Card choices made by the respondents are valid empirical expressions of their judgment.
5. The presence of the researcher has not unduly influenced the responses of the respondents.

In most instances, hypotheses were stated in the directional form. Hypotheses were based on the literature reviewed, and on the experience of the researcher as an educator in engineering design and drafting technology.

Hypotheses are numbered consecutively hereunder, and are referred to by these numbers in the following chapters.

1-6 ABSTRACTION VS. NEUTRALITY AND APPLICATION ITEMS:

Of the 278 items, the researcher classified 64 as abstract definitions of knowledge, 97 as neutral (middle of the scale from abstraction to application), and 117 as practical application, as detailed by item number in Appendix H.

It was hypothesized that:

1. Proportionately more instructors will rank abstraction items higher than will all graduates.
2. Proportionately more instructors will rank abstraction items higher than will graduates in the supervisory group.
3. Proportionately more instructors will rank abstraction items higher than will graduates in the supervisee group.
4. Proportionately more supervisors will rank abstraction items higher than will graduates in the supervisee group.

5. Proportionately more graduates with four or more years of experience by employment will rank more abstraction items higher than will graduates with three or fewer years of experience.

6. Application items will carry consistently higher rank than neutral or abstraction items.

7-11 BY FIELDS OF SPECIALIZATION:

All 60 responding graduates were grouped by their primary fields of specialization (Appendix L), and card items were classified as to their importance to these specializations (Appendix J).

It was hypothesized that:

7. Proportionately more graduates working in the civil/municipal area will rank items listed higher than will graduates in other fields of specialization.

8. Proportionately more graduates working in the electrical/electronic area will rank items listed higher than will graduates in other fields of specialization.

9. Proportionately more graduates working in the mechanical area will rank items listed higher than will graduates in other fields of specialization.

10. Proportionately more graduates working in the structural area will rank items listed higher than will graduates in other fields of specialization.

11. Proportionately more graduates working in the topographic area will rank items listed higher than will graduates in other fields of specialization.

12-15 IDENTIFYING THE CORE CURRICULUM:

Card items deemed by educators to constitute curriculum content common to all fields of specialization were isolated (Appendix K).

It was hypothesized that:

12. There is no significant difference in perception between instructors and all graduates relative to agreement on knowledges and skills common to all fields of specialization.
13. There is no significant difference in perception between instructors and supervisors relative to agreement on knowledges and skills common to all fields of specialization.
14. There is no significant difference in perception between instructors and supervisees relative to agreement on knowledges and skills common to all fields of specialization.
15. There is no significant difference in perception between supervisors and supervisees relative to agreement on knowledges and skills common to all fields of specialization.

I addition to the testing of hypotheses, as enumerated from 1 to 15 above, rank order by frequency was tabulated as shown in Table 4.16 and comprising the following response categories:

16. Items judged "essential".
17. Items judged "essential" and "related", in combination.
18. Items judged "related" and "somewhat related", in combination.
19. Items judged "unrelated".

POPULATION AND SAMPLE

As stated in Chapter 1, p. 10, herein, the population of this study consists of all graduates of the Engineering Design and Drafting Technology (previously titled Drafting Technology) program at N.A.I.T. since 1965, to which the results of this study may be generalizable. During this period, i.e., from June, 1965 to June 1976, both inclusive, 274 graduates from the program were awarded their diplomas in technology. Of these 274 graduates, 136 could be identified by place of employment or residence. Of these a sample of 60 were contacted.

COLLECTION OF DATA

The research instruments were administered to 11 N.A.I.T. instructors in June, 1976, and to 60 graduates during the months of July and August, 1976. Combined sessions for the performance of the card sort, completion of the questionnaire, and conducting of the interview were held by appointment with individuals or groups numbering from 2 to 4 respondents. The duration of these sessions varied from 60 to 80 minutes each. After the completion of such sessions, the investigator entered the results of the card sort in a check list (Appendix M) for subsequent use in statistical analysis.

The respondents were instructed to sort the cards into four piles according to their work experience, as follows:

(1) "Essential" - knowledges and skills required in daily work.

(2) "Related" - necessary background knowledge, skill or activity, of frequent application.

(3) "Somewhat related" - good to know, but occurring less frequently than (2) above.

(4) "Unrelated" - not required or encountered in respondent's field of specialization.

DATA ANALYSIS

Data compilation was performed using the CDC 6400 KRONOS 2.1.2/420 computer system at N.A.I.T.

It was decided to use the value of ten per cent difference as being satisfactory in distinguishing the number of elements placed in the same category by different groups.

The following example will illustrate the procedure:

In table 4.1, page 43, the differences in columns "Essential" and "Somewhat related" are 17.5 - 08.4 = 9.1 and 25.4 - 21.6 = 3.8; 9.1 and 3.8 being lower than 10%, these differences are judged as insignificant. In columns "Related" and "Unrelated", the differences are 28.4 - 11.3 = 19.1 and 58.7 - 28.7 = 30.0 respectively; 19.1 and 30.0 each are higher than 10%, therefore these differences are judged as significant.

CHAPTER 4

ANALYSIS OF DATA

GENERAL

This chapter is concerned with the presentation and discussion of the data.

Four groups are compared in this chapter:

(1) instructors,

(2) graduates in supervisory positions,

(3) graduates in non-supervisory ("supervisee") positions,

(4) all graduate respondents.

The data are examined under the following headings:

(A) Abstraction vs. neutrality and application items (hypotheses 1 - 6),

(B) Comparisons by fields of specialization (hypotheses 7 - 11),

(C) Identification of the core curriculum (hypotheses 12 - 15),

(D) Rank order of importance by frequency.

In tables 4.1 to 4.15, the first number in each cell is the product of the actual frequency multiplied by the number of items, while the number in parenthesis is the corresponding percentage. In the explanations following the tables, reference is made to the differences in percentage of two groups, items, or fields of specialization (as illustrated by the example given on page 41.

(A) ABSTRACTION VS. NEUTRALITY AND APPLICATION ITEMS

It was expected that, generally, application items of the curriculum, i.e. "hands-on" items, would carry consistently higher rank in the choices of respondents than would neutral or abstraction items.

Hypotheses 1 to 6 were tested to obtain valid data on how the three groups of respondents - instructors, supervisors and supervisees (and the latter two combined) - compared in their perceptions.

For this purpose the total of 278 items was classified under the three appropriate headings (Abstraction, Neutral, Application), as listed in Appendix H and as indicated on page 37 of this study.

The following results were obtained:

HYPOTHESIS 1: PROPORTIONATELY MORE INSTRUCTORS (n = 11) WILL RANK ABSTRACTION ITEMS HIGHER THAN WILL ALL GRADUATES (n = 60).

TABLE 4.1 Instructors vs. all graduates responses on abstract items

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
INSTRUCTORS	125 (17.5)	203 (28.4)	182 (25.4)	205 (28.7)	715 (100.0)
GRADUATES	329 (08.4)	442 (11.3)	841 (21.6)	2288 (58.7)	3900 (100.0)
Σ	454 (09.8)	645 (14.0)	1023 (22.2)	2493 (54.0)	4615 (100.0)

In the ranking of abstraction items, item responses by instructors and all graduates were significantly different in the "related" (17.1%) and in the "unrelated" (30.0%) areas, based on the previously stated criteria. No significant difference was found in the "essential" (9.1%) and "somewhat related" (3.8%) areas.

HYPOTHESIS 2: PROPORTIONATELY MORE INSTRUCTORS (n = 11) WILL RANK ABSTRACTION ITEMS HIGHER THAN WILL GRADUATES IN THE SUPERVISORY GROUP (n = 20)

TABLE 4.2 Instructors vs. supervisors responses on abstract items

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
INSTRUCTORS	125 (17.5)	203 (28.4)	182 (25.4)	205 (28.7)	715 (100.0)
SUPERVISORS	159 (12.2)	186 (14.3)	283 (21.8)	672 (51.7)	1300 (100.0)
Σ	284 (14.1)	389 (19.3)	465 (23.1)	877 (43.5)	2015 (100.0)

This hypothesis was rejected in the "essential" (5.3%) and in the "somewhat related" (3.6%) areas, but was confirmed in the "related" (14.1%) and in the "unrelated" (33.0%) areas.

HYPOTHESIS 3: PROPORTIONATELY MORE INSTRUCTORS (n = 11) WILL RANK ABSTRACTION ITEMS HIGHER THAN WILL GRADUATES IN THE SUPERVISEE GROUP (n = 40)

TABLE 4.3 Instructors vs. supervisees responses on abstract items

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
INSTRUCTORS	125 (17.5)	203 (28.4)	182 (25.4)	205 (28.7)	715 (100)
SUPERVISEES	170 (06.5)	256 (09.8)	558 (21.5)	1616 (62.2)	2600 (100)
Σ	295 (08.9)	459 (13.9)	740 (22.3)	1821 (54.9)	3315 (100)

There is a noted difference between the two groups in the ranking of abstraction items in the "essential" (11.0%), "related" (18.6%) and "unrelated" (33.5%) areas, but not in the "somewhat related" (3.9%) area.

HYPOTHESIS 4: PROPORTIONATELY MORE SUPERVISORS (n = 20) WILL RANK ABSTRACTION ITEMS HIGHER THAN WILL SUPERVISEES (n = 40)

TABLE 4.4 Supervisors vs. supervisees responses on abstract items

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
SUPERVISORS	159 (12.2)	186 (14.3)	283 (21.8)	672 (51.7)	1300 (100.0)
SUPERVISEES	170 (06.5)	256 (09.8)	558 (21.5)	1616 (62.2)	2600 (100.0)
Σ	329 (08.4)	442 (11.3)	841 (21.6)	2288 (58.7)	3900 (100.0)

In the ranking of abstraction items, no appreciable difference was found in the "essential" (5.7%), "related" (4.5%) and "somewhat related" (0.3%) areas, while in the "unrelated" (10.5%) area the criterion of 10% was just barely met.

HYPOTHESIS 5: PROPORTIONATELY MORE GRADUATES WITH FOUR OR MORE YEARS OF EXPERIENCE BY EMPLOYMENT (n = 25) WILL RANK MORE ABSTRACTION ITEMS HIGHER THAN GRADUATES WITH THREE OR FEWER YEARS OF EXPERIENCE (n = 35)

TABLE 4.5 Graduates with four or more vs. graduates with three or fewer years of experience

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
4 YEARS OR MORE	191 (11.8)	195 (12.0)	317 (19.5)	922 (56.7)	1625 (100.0)
3 YEARS OR LESS	138 (06.1)	247 (10.9)	524 (23.0)	1366 (60.0)	2275 (100.0)
Σ	329 (08.4)	442 (11.3)	841 (21.6)	2288 (58.7)	3900 (100.0)

No significant difference was found in the ranking of abstraction items. The item responses by the two groups of graduates differed only as follows: "essential": 5.7%, "related": 1.1%, "somewhat related": 3.5%, "unrelated": 1.3%. The hypothesis has been rejected.

HYPOTHESIS 6: APPLICATION ITEMS (n = 118) WILL CARRY CONSISTENTLY HIGHER RANK THAN NEUTRAL OR ABSTRACTION ITEMS (n = 160)

TABLE 4.6 Application vs. neutral and abstraction items as perceived by all respondents

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
APPLICATION ITEMS	1879 (22.8)	1430 (17.4)	1738 (21.1)	3189 (38.7)	8236 (100.0)
ABSTRACT AND NEUTRAL ITEMS	1656 (14.4)	1824 (15.8)	2632 (22.9)	5390 (46.9)	11502 (100.0)
Σ	3535 (17.9)	3254 (16.5)	4370 (22.1)	8579 (43.5)	19738 (100.0)

There is no significant difference between the two groups of items. The hypothesis is rejected. The item responses differed as follows: "essential": 8.4%, "related": 1.6%, "somewhat related": 1.8%, "unrelated": 8.2%; therefore, all below the criterion of 10% previously stated.

The findings suggest that, when considering the total sample, close to equal value is placed in application or "hands on" items of the curriculum as in abstract and neutral items. When comparing the groups of respondents, it was shown that years of experience did little to influence the choice of abstraction items as essential to the job and, therefore, to the curriculum. This was evidenced by similar values assigned by instructors and by all graduates regarding items deemed essential. This was also shown by the closely similar values assigned by supervisors as compared with those assigned by supervisees, and by the similar values assigned by graduates with longer spans of experience and those with shorter spans of experience. This may be interpreted to mean that, within the time range of employment of graduates (which in no case exceeded eleven years), and regardless of the wider scope of duties and responsibilities of some of the respondents, items of an abstract nature were seen as equally important by most respondents.

The conclusions drawn from these results will be reported on in Chapter 5, page 60 ff.

(B) COMPARISONS BY FIELDS OF SPECIALIZATION

To identify curricular items and areas of particular importance to practitioners in certain fields of engineering specialization, with a view to specialty courses mandatory for all students as well as to the offering of electives, all responding graduates (n = 60) were grouped by their primary fields of specialization (Civil/Municipal n = 20, Electrical/Electronic n = 13, Mechanical n = 11, Structural n = 8, and Topographic n = 8), as listed in Appendix L.

For each of these five fields of specialization, the researcher isolated a number of card items (Appendix J), hypothesizing that, in each instance, proportionately more graduates working in that field of specialization would rank the specialty items selected higher than would graduates in other fields of specialization.

The following results were obtained:

HYPOTHESIS 7: PROPORTIONATELY MORE GRADUATES WORKING IN THE CIVIL/MUNICIPAL AREA (n = 20) WILL RANK ITEMS 006-026, 033-037, 039-041, 186-202, 229-240 and 248-251 HIGHER THAN WILL GRADUATES IN OTHER FIELDS OF SPECIALIZATION (n = 40)

TABLE 4.7 Civil/Municipal vs. other fields

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
CIVIL/MUNICIPAL	349 (28.2)	165 (13.3)	211 (17.0)	515 (41.5)	1240 (100.0)
OTHER FIELDS	339 (13.7)	358 (14.4)	606 (24.4)	1177 (47.5)	2480 (100.0)
Σ	688 (18.5)	523 (14.0)	817 (22.0)	1692 (45.5)	3720 (100.0)

There is a difference between the two groups in the "essential" area (14.5%) while in all other areas ("related": 1.1%, "somewhat related": 7.4%, "unrelated": 6.0%) no significant difference - in terms of the accepted criterion of 10% - was found.

HYPOTHESIS 8: PROPORTIONATELY MORE GRADUATES WORKING IN THE ELECTRICAL/ELECTRONIC AREA (n = 13) WILL RANK ITEMS 012-018, 101-107, 151-161 and 229-240 HIGHER THAN WILL GRADUATES IN OTHER FIELDS OF SPECIALIZATION (n = 47)

TABLE 4.8 Electrical/Electronic vs. other fields

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
ELECTRICAL / ELECTRONIC	59 (12.3)	69 (14.3)	108 (22.5)	245 (50.9)	481 (100.0)
OTHER FIELDS	69 (04.0)	127 (07.3)	317 (18.2)	1226 (70.5)	1739 (100.0)
Σ	128 (05.8)	196 (08.8)	425 (19.1)	1471 (66.3)	2220 (100.0)

No substantial difference was noted in the ranking of "essential" (8.3%), "related" (7.0%) and "somewhat related" (4.3%) response items. A noted difference was found in the judging of items classified as "unrelated" (19.6%).

HYPOTHESIS 9: PROPORTIONATELY MORE GRADUATES WORKING IN THE MECHANICAL AREA (n = 11) WILL RANK ITEMS 006-018, 084-100, 252-260 and 269-278 HIGHER THAN WILL GRADUATES IN OTHER FIELDS OF SPECIALIZATION (n = 49)

TABLE 4.9 Mechanical vs. other fields

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
MECHANICAL	208 (34.4)	142 (23.5)	148 (24.4)	107 (17.7)	605 (100.0)
OTHER FIELDS	196 (07.3)	246 (09.1)	549 (20.4)	1704 (63.2)	2695 (100.0)
Σ	404 (12.2)	388 (11.8)	697 (21.1)	1811 (54.9)	3300 (100.0)

Substantial differences were established when comparing the two groups' item responses in the "essential" (27.1%), "related" (14.4%) and "unrelated" (45.5%) areas. There was little disagreement in the "somewhat related" (4.0%) area of item responses.

HYPOTHESIS 10: PROPORTIONATELY MORE GRADUATES WORKING IN THE STRUCTURAL AREA (n = 8) WILL RANK ITEMS 039-041, 108-150 and 248-268 HIGHER THAN WILL GRADUATES IN OTHER FIELDS OF SPECIALIZATION (n = 52).

TABLE 4.10 Structural vs. other fields

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
STRUCTURAL	224 (41.8)	107 (20.0)	112 (20.9)	93 (17.3)	536 (100.0)
OTHER FIELDS	311 (08.9)	527 (15.1)	889 (25.5)	1757 (50.5)	3484 (100.0)
Σ	535 (13.3)	634 15.8)	1001 (24.9)	1850 (46.0)	4020 (100.0)

A high degree of disagreement was established in the extreme areas of rating, i.e., "essential" (32.9%) and "unrelated" (33.2%), while in the more closely grouped middle areas, "related" (4.9%) and "somewhat related" (4.6%) the two groups showed very close agreement.

HYPOTHESIS 11: PROPORTIONATELY MORE GRADUATES WORKING IN THE TOPOGRAPHIC AREA (n = 8) WILL RANK ITEMS 019-070, 253, and 264-268 HIGHER THAN WILL GRADUATES IN OTHER FIELDS OF SPECIALIZATION (n = 52).

TABLE 4.11 Topographic vs. other fields

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
TOPOGRAPHIC	94 (20.3)	53 (11.4)	89 (19.2)	228 (49.1)	464 (100.0)
OTHER FIELDS	573 (19.0)	507 (16.8)	658 (21.8)	1278 (42.4)	3016 (100.0)
Σ	667 (19.1)	560 (16.1)	747 (21.5)	1506 (43.3)	3480 (100.0)

There is no significant difference between these two groups in any of the item response categories. The responses differed in percentage only as follows: "essential": 1.3%, "related": 5.4%, "somewhat related": 2.6%, "unrelated": 6.7%. The hypothesis was rejected. The percentages of graduates working in the topographic field and of all others are very close in all four categories, suggesting approximately equal importance, or lack of importance, of all these items to all graduates.

(C) IDENTIFICATION OF THE CORE CURRICULUM

In an effort to identify the core curriculum, as perceived by all respondents to represent knowledges and skills common to all fields of specialization, the researcher isolated a number of card items, listed in Appendix K, and applied null hypotheses in each of the following four comparisons:

HYPOTHESIS 12: THERE IS NO SIGNIFICANT DIFFERENCE IN PERCEPTION BETWEEN INSTRUCTORS (n = 11) AND ALL GRADUATES (n = 60) RELATIVE TO AGREEMENT ON KNOWLEDGES AND SKILLS COMMON TO ALL FIELDS OF SPECIALIZATION.

TABLE 4.12 Instructors vs. all graduates

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
INSTRUCTORS	174 (23.3)	209 (27.9)	189 (25.3)	176 (23.5)	748 (100.0)
GRADUATES	1007 (24.7)	688 (16.8)	966 (23.7)	1419 (34.8)	4080 (100.0)
Σ	1181 (24.5)	897 (18.6)	1155 (23.9)	1595 (33.0)	4828 (100.0)

The null hypothesis is confirmed in the area of response items classified as "essential" (1.4%) and "somewhat related" (1.6%) while with respect to items in categories "related" (11.1%) and "unrelated" (11.3%), the criterion of 10% has been exceeded.

HYPOTHESIS 13: THERE IS NO SIGNIFICANT DIFFERENCE IN PERCEPTION BETWEEN INSTRUCTORS (n = 11) AND SUPERVISORS (n = 20) RELATIVE TO AGREEMENT ON KNOWLEDGES AND SKILLS COMMON TO ALL FIELDS OF SPECIALIZATION.

TABLE 4.13 Instructors vs. supervisors

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
INSTRUCTORS	174 (23.3)	209 (27.9)	189 (25.3)	176 (23.5)	748 (100.0)
SUPERVISORS	433 (31.8)	255 (18.8)	310 (22.8)	362 (26.6)	1360 (100.0)
Σ	607 (28.8)	464 (22.0)	499 (23.7)	538 (25.5)	2108 (100.0)

The null hypothesis was confirmed. Item responses of instructors and supervisors differ only by 8.5% in the "essential" area, by 9.1% in "unrelated", by 2.5% in "somewhat related", and by 3.1% in "unrelated".

HYPOTHESIS 14: THERE IS NO SIGNIFICANT DIFFERENCE IN PERCEPTION BETWEEN INSTRUCTORS (n = 11) AND SUPERVISEES (n = 40) RELATIVE TO AGREEMENT ON KNOWLEDGES AND SKILLS COMMON TO ALL FIELDS OF SPECIALIZATION.

TABLE 4.14 Instructors vs. supervisees

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
INSTRUCTORS	174 (23.3)	209 (27.9)	189 (25.3)	176 (23.5)	748 (100.0)
SUPERVISEES	574 (21.1)	433 (15.9)	656 (24.1)	1057 (38.9)	2720 (100.0)
Σ	748 (21.6)	642 (18.5)	845 (24.4)	1233 (35.5)	3468 (100.0)

There is a noted difference between item responses classified as "related" (12.0%) and "unrelated" (15.4%), but no significant difference in the other two areas: "essential" (2.2%) and "somewhat related" (1.2%).

HYPOTHESIS 15: THERE IS NO SIGNIFICANT DIFFERENCE IN PERCEPTION BETWEEN SUPERVISORS (n = 20) AND SUPERVISEES (n = 40) RELATIVE TO AGREEMENT ON KNOWLEDGES AND SKILLS COMMON TO ALL FIELDS OF SPECIALIZATION.

TABLE 4.15 Supervisors vs. supervisees

	ESSENTIAL	RELATED	SOMEWHAT RELATED	UNRELATED	Σ
SUPERVISORS	433 (31.8)	255 (18.8)	310 (22.8)	362 (26.6)	1360 (100.0)
SUPERVISEES	574 (21.1)	433 (15.9)	656 (24.1)	1057 (38.9)	2720 (100.0)
Σ	1007 (24.7)	688 (16.9)	966 (23.6)	1419 (34.8)	4080 (100.0)

A notable degree of disagreement existed between the two groups in the extreme areas of ranking, i.e., "essential (10.7%) and "unrelated" (12.3%), while in the more closely grouped middle areas, "related" (2.9%) and "somewhat related" (1.3%) close agreement was indicated.

(D) RANK ORDER OF IMPORTANCE BY FREQUENCY

The rank order of the frequency with which cards were selected, and assigned to the four categories from "essential" to "unrelated", is recorded on pages 54 to 59, Table 4.16. Rank order is shown for four groupings: "essential", combined "essential/related", combined "related /somewhat related", and "unrelated". (A legend is given on page 59.) This table is included for the benefit of the educator concerned with program revision. To further facilitate that person's decision making, tables are provided in Appendices N and O, listing card items in numerical order, and in Appendix D which shows the relationship to individual courses or subject areas.

TABLE 4.16 Frequency Rank Order

ESSENTIAL			ESSENTIAL OR RELATED			RELATED OR SOMEWHAT RELATED			UNRELATED		
#	*f*	*c*	#	*f*	*c*	#	*f*	*c*	#	*f*	*c*
74	65	*	78	69	*	223	45	*	28	60	T
78	62	*	71	68	*	166	44	*	247	56	M
71	61	*	74	68	*	167	42	*	104	55	E
73	59	*	73	65	*	169	42	*	105	55	E
79	47	*	72	63	*	2	41	*	106	55	E
72	44	*	215	61	*	33	41	CT	238	55	CE
75	44	*	79	58	*	173	41	*	65	54	T
215	42	*	20	57	CT	222	41	*	66	54	T
20	40	CT	41	57	CST	1	40	*	69	54	T
21	39	CT	253	56	MST	3	40	*	100	54	M
41	39	CST	49	55	T	37	40	CT	62	53	T
25	38	CT	169	55	*	80	40	*	64	53	T
19	34	CT	75	54	*	108	40	S	14	52	CEM
22	33	CT	21	53	CT	266	40	ST	16	52	CEM
87	33	M	205	53	*	6	39	CM	103	52	E
253	33	MST	19	52	CT	176	39	*	234	52	CE
49	32	T	203	52	*	44	38	T	237	52	CE
83	32	*	25	50	CT	76	38	*	4	51	*
204	32	*	83	50	*	177	38	*	68	51	T
23	31	CT	187	48	C	211	38	*	70	51	T
203	31	*	188	48	C	212	38	*	101	51	E
205	31	*	204	48	*	249	38	CS	158	51	E
40	30	CST	82	47	*	8	37	CM	233	51	CE
82	30	*	210	47	*	42	37	T	30	50	T
210	30	*	42	46	T	77	37	*	102	50	E
24	29	CT	171	46	*	209	37	*	221	50	*
86	29	M	206	45	*	248	37	CS	29	49	T
187	29	C	212	45	*	267	37	ST	35	49	CT
188	29	C	22	44	CT	49	36	T	107	49	E
206	29	*	23	44	CT	219	36	*	165	49	*
55	28	T	166	44	*	225	36	*	5	48	*
189	28	C	173	44	*	9	35	CM	208	48	*
200	28	C	189	44	C	36	35	CT	17	47	CEM
26	27	CT	80	43	*	43	35	T	58	47	T
169	27	*	268	43	ST	45	35	T	60	47	T
199	27	C	26	42	CT	56	35	T	61	47	T
201	27	C	44	42	T	81	35	*	164	47	*
88	26	M	77	42	*	109	35	S	236	47	CE
171	26	*	266	42	ST	113	35	S	97	46	M
54	25	T	56	41	T	151	35	E	240	46	CE
77	25	*	37	40	CT	171	35	*	278	46	M
192	25	C	40	40	CST	178	35	*	27	45	T
110	24	S	87	40	M	184	35	*	59	45	T
212	24	*	24	39	CT	186	35	C	99	45	M
42	23	T	86	39	M	51	34	T	239	45	CE
80	23	*	186	39	C	63	34	T	18	44	CEM
84	23	M	54	38	T	162	34	*	98	44	M
112	23	S	110	38	S	172	34	*	241	44	M
268	23	ST	211	38	*	210	34	*	242	44	M
56	22	T	264	38	ST	227	34	*	150	43	S

ESSENTIAL			ESSENTIAL OR RELATED			RELATED OR SOMEWHAT RELATED			UNRELATED		
#	*f*	*c*	#	*f*	*c*	#	*f*	*c*	#	*f*	*c*
173	22	*	267	38	ST	246	34	M	156	43	E
211	22	*	45	37	T	264	34	ST	159	43	E
85	21	M	84	37	M	265	34	ST	183	43	*
89	21	M	88	37	M	7	33	CM	218	43	*
138	20	S	112	37	S	39	33	CST	231	43	CE
209	20	*	192	37	C	47	33	T	232	43	CE
266	20	ST	199	37	C	52	33	T	245	43	M
44	19	T	209	37	*	117	33	S	15	42	CEM
46	19	T	55	36	T	136	33	S	96	42	M
147	19	S	85	36	M	142	33	S	259	42	MS
191	19	C	265	36	ST	147	33	S	13	41	CEM
264	19	ST	76	35	*	152	33	E	32	41	CT
76	18	*	223	35	*	187	33	C	38	41	T
186	18	C	33	34	CT	197	33	C	146	41	S
196	18	C	120	34	S	207	33	*	214	41	*
202	18	C	191	34	C	216	33	*	235	41	CE
119	17	S	200	34	C	229	33	CE	91	40	M
137	17	S	201	34	C	257	33	MS	181	40	*
166	17	*	46	33	T	19	32	CT	182	40	*
184	17	*	89	33	M	31	32	T	226	40	*
37	16	CT	111	33	S	34	32	CT	243	40	M
39	16	CST	114	33	S	46	32	T	252	40	MS
45	16	T	119	33	S	82	32	*	271	40	M
81	16	*	115	32	S	83	32	*	155	39	E
111	16	S	207	32	*	115	32	S	157	39	E
120	16	S	1	31	*	116	32	S	170	39	*
121	16	S	48	31	T	130	32	S	224	39	*
131	16	S	81	31	*	143	32	S	256	39	MS
132	16	S	113	31	S	154	32	E	258	39	MS
140	16	S	147	31	S	163	32	*	273	39	M
190	16	C	190	31	C	174	32	*	12	38	CEM
1	15	*	131	30	S	196	32	C	34	38	CT
2	15	*	137	30	S	203	32	*	53	38	T
33	15	CT	138	30	S	250	32	CS	122	38	S
48	15	T	151	30	E	253	32	MST	133	38	S
94	15	M	196	30	C	255	32	MS	135	38	S
136	15	S	202	30	C	277	32	M	175	38	*
260	15	MS	2	29	*	10	31	CM	185	38	*
151	14	E	136	29	S	50	31	T	198	38	C
179	14	*	152	29	E	124	31	S	244	38	M
193	14	C	275	29	M	131	31	S	272	38	M
207	14	*	132	28	S	132	31	S	11	37	CM
265	14	ST	222	28	*	168	31	*	67	37	T
267	14	ST	90	27	M	190	31	C	127	37	S
274	14	M	153	27	E	192	31	C	141	37	S
114	13	S	184	27	*	198	31	C	145	37	S
115	13	S	193	27	C	205	31	*	149	37	S
118	13	S	225	27	*	217	31	*	161	37	E
130	13	S	274	27	M	220	31	*	228	37	*
134	13	S	50	26	T	251	31	CS	254	37	MS

ESSENTIAL			ESSENTIAL OR RELATED			RELATED OR SOMEWHAT RELATED			UNRELATED		
#	*f*	*c*	#	*f*	*c*	#	*f*	*c*	#	*f*	*c*
176	13	*	121	26	S	268	31	ST	262	37	S
275	13	M	140	26	S	272	31	M	263	37	S
128	12	S	172	26	*	89	30	M	270	37	M
152	12	E	179	26	*	114	30	S	31	36	T
153	12	E	180	26	*	121	30	S	92	36	M
160	12	E	213	26	*	144	30	S	95	36	M
180	12	*	6	25	CM	179	30	*	126	36	S
194	12	C	39	25	CST	206	30	*	129	36	S
261	12	S	43	25	T	213	30	*	144	36	S
50	11	T	93	25	M	230	30	CE	160	36	E
90	11	M	130	25	S	244	30	M	276	36	M
93	11	M	118	24	S	276	30	M	90	35	M
109	11	S	148	24	S	53	29	T	139	35	S
122	11	S	154	24	E	85	29	M	163	35	*
123	11	S	176	24	*	125	29	S	195	35	C
129	11	S	194	24	C	126	29	S	47	34	T
148	11	S	260	24	MS	137	29	S	57	34	T
157	11	E	9	23	CM	148	29	S	124	34	S
161	11	E	51	23	T	153	29	E	125	34	S
213	11	*	94	23	M	185	29	*	128	34	S
223	11	*	108	23	S	193	29	C	143	34	S
51	10	CT	109	23	S	194	29	C	217	34	*
91	10	M	125	23	S	195	29	C	220	34	*
92	10	M	142	23	S	228	29	*	251	34	CS
95	10	M	178	23	*	269	29	M	269	34	M
99	10	M	248	23	CS	275	29	M	277	34	M
113	10	S	277	23	M	11	28	CM	63	33	T
116	10	S	3	22	*	12	28	CEM	93	33	M
139	10	S	91	22	M	20	28	CT	123	33	S
145	10	S	116	22	S	26	28	CT	134	33	S
172	10	*	134	22	S	57	28	T	180	33	*
222	10	*	141	22	S	112	28	S	197	33	C
258	10	MS	162	22	*	119	28	S	250	33	CS
262	10	S	7	21	CM	120	28	S	261	33	S
270	10	M	10	21	CM	155	28	E	10	32	CM
271	10	M	52	21	T	175	28	*	94	32	M
3	9	*	92	21	M	188	28	C	140	32	S
52	9	T	95	21	M	204	28	*	168	32	*
57	9	T	96	21	M	224	28	*	174	32	*
96	9	M	127	21	S	243	28	M	216	32	*
97	9	M	128	21	S	263	28	S	230	32	CE
98	9	M	129	21	S	274	28	M	255	32	MS
135	9	S	139	21	S	38	27	T	260	32	MS
149	9	S	160	21	E	48	27	T	117	31	S
154	9	E	174	21	*	84	27	M	118	31	S
178	9	*	256	21	MS	93	27	M	142	31	S
225	9	*	262	21	S	111	27	S	148	31	S
229	9	CE	8	20	CM	118	27	S	202	31	C
230	9	CE	57	20	T	123	27	S	7	30	CM
248	9	CS	126	20	S	127	27	S	43	30	T

ESSENTIAL			ESSENTIAL OR RELATED			SOMEWHAT RELATED			UNRELATED		
#	f	c	#	f	c	#	f	c	#	f	c
254	9	MS	157	20	E	141	27	S	153	30	E
273	9	M	216	20	*	170	27	*	154	30	E
6	8	CM	246	20	M	191	27	C	194	30	C
7	8	CM	249	20	CS	256	27	MS	213	30	*
10	8	CM	254	20	MS	22	26	CT	227	30	*
36	8	CT	255	20	MS	27	26	T	246	30	M
67	8	T	261	20	S	41	26	CST	257	30	MS
125	8	S	263	20	S	67	26	T	9	29	CM
146	8	S	270	20	M	86	26	M	48	29	T
159	8	E	36	19	CT	88	26	M	50	29	T
162	8	*	67	19	T	133	26	S	52	29	T
168	8	*	97	19	M	139	26	S	116	29	S
252	8	MS	149	19	S	180	26	*	162	29	*
257	8	MS	168	19	*	181	26	*	219	29	*
259	8	MS	269	19	M	183	26	*	229	29	CE
269	8	M	133	18	S	215	26	*	274	29	M
9	7	CM	145	18	S	245	26	M	275	29	M
117	7	S	163	18	*	261	26	S	8	28	CM
127	7	S	219	18	*	18	25	CEM	36	28	CT
133	7	S	220	18	*	32	25	T	111	28	S
141	7	S	271	18	M	40	25	CST	114	28	S
142	7	S	273	18	M	54	25	T	193	28	C
174	7	*	63	17	T	72	25	*	51	27	T
177	7	*	98	17	M	90	25	M	120	27	S
195	7	C	122	17	S	92	25	M	138	27	S
226	7	*	123	17	S	95	25	M	172	27	*
227	7	*	135	17	S	110	25	S	178	27	*
231	7	CE	167	17	*	128	25	S	179	27	*
246	7	M	170	17	*	134	25	S	200	27	C
249	7	CS	177	17	*	149	25	S	201	27	C
255	7	MS	197	17	C	182	25	*	113	26	S
8	6	CM	227	17	*	214	25	*	115	26	S
11	6	CM	229	17	CE	242	25	M	119	26	S
13	6	CEM	250	17	CS	254	25	MS	130	26	S
43	6	T	251	17	CS	13	24	CEM	152	26	E
108	6	S	257	17	MS	15	24	CEM	177	26	*
124	6	S	258	17	MS	21	24	CT	225	26	*
126	6	S	259	17	MS	24	24	CT	249	26	CS
182	6	*	99	16	M	94	24	M	108	25	S
216	6	*	117	16	S	129	24	S	109	25	S
217	6	*	124	16	S	135	24	S	121	25	S
219	6	*	143	16	S	138	24	S	137	25	S
220	6	*	144	16	S	145	24	S	167	25	*
232	6	CE	146	16	S	150	24	S	191	25	C
235	6	CE	161	16	E	156	24	E	199	25	C
240	6	CE	175	16	*	189	24	C	248	25	CS
250	6	CS	195	16	C	218	24	*	6	24	CM
251	6	CS	217	16	*	226	24	*	131	24	S
263	6	S	235	16	CE	235	24	CE	132	24	S
12	5	CEM	244	16	M	241	24	M	190	24	C

ESSENTIAL			ESSENTIAL OR RELATED			RELATED OR SOMEWHAT RELATED			UNRELATED		
#	*f*	*c*	#	*f*	*c*	#	*f*	*c*	#	*f*	*c*
15	5	CEM	276	16	M	260	24	MS	207	24	*
32	5	T	47	15	T	262	24	S	136	23	S
59	5	T	159	15	E	270	24	M	265	23	ST
143	5	S	181	15	*	23	23	CT	3	22	*
144	5	S	182	15	*	25	23	CT	39	22	CST
170	5	*	230	15	CE	140	23	S	110	22	S
175	5	*	239	15	CE	160	23	E	151	22	E
181	5	*	252	15	MS	161	23	E	54	21	T
197	5	C	18	14	CEM	164	23	*	55	21	T
214	5	*	34	14	CT	252	23	MS	84	21	M
228	5	*	228	14	*	273	23	M	85	21	M
236	5	CE	231	14	CE	17	22	CEM	196	21	C
239	5	CE	236	14	CE	29	22	T	45	20	T
256	5	MS	243	14	M	35	22	CT	46	20	T
276	5	M	11	13	CM	55	22	T	81	20	*
277	5	M	155	13	E	61	22	T	89	20	M
47	4	T	156	13	E	87	22	M	112	20	S
53	4	T	226	13	*	122	22	S	222	20	*
63	4	T	240	13	CE	146	22	S	267	20	ST
150	4	S	15	12	CEM	202	22	C	88	19	M
155	4	E	38	12	T	232	22	CE	147	19	S
156	4	E	53	12	T	258	22	MS	176	19	*
163	4	*	232	12	CE	30	21	T	184	19	*
167	4	*	234	12	CE	58	21	T	189	19	C
185	4	*	5	11	*	59	21	T	24	18	CT
218	4	*	31	11	T	60	21	T	186	18	C
224	4	*	32	11	T	91	21	M	264	18	ST
233	4	CE	59	11	T	102	21	E	23	17	CT
237	4	CE	150	11	S	157	21	E	268	17	ST
278	4	M	185	11	*	165	21	*	1	16	*
4	3	*	208	11	*	208	21	*	26	16	CT
5	3	*	214	11	*	231	21	CE	40	16	CST
14	3	CEM	224	11	*	239	21	CE	86	16	M
31	3	T	242	11	M	259	21	MS	87	16	M
38	3	T	245	11	M	271	21	M	2	15	*
58	3	T	13	10	CEM	278	21	M	33	15	CT
60	3	T	16	10	CEM	5	20	*	37	15	CT
64	3	T	60	10	T	96	20	M	76	15	*
107	3	E	61	10	T	101	20	E	192	15	C
234	3	CE	107	10	E	159	20	E	223	15	*
241	3	M	233	10	CE	68	19	T	44	14	T
243	3	M	238	10	CE	70	19	T	56	14	T
244	3	M	241	10	M	103	19	E	188	14	C
17	2	CEM	278	10	M	107	19	E	209	14	*
18	2	CEM	58	9	T	199	19	C	22	12	CT
61	2	T	64	9	T	221	19	*	206	12	*
66	2	T	69	9	T	236	19	CE	42	11	T
69	2	T	100	9	M	240	19	CE	204	11	*
158	2	E	102	9	E	16	18	CEM	211	11	*
183	2	*	198	9	C	79	18	*	266	11	ST

ESSENTIAL			ESSENTIAL OR RELATED			RELATED SOMEWHAT RELATED			UNRELATED		
#	_f_	_c_	#	_f_	_c_	#	_f_	_c_	#	_f_	_c_
198	2	C	237	9	CE	98	18	M	25	10	CT
208	2	*	272	9	M	158	18	E	75	10	*
221	2	*	12	8	CEM	4	17	*	166	10	*
238	2	CE	14	8	CEM	62	17	T	171	10	*
242	2	M	17	8	CEM	75	17	*	77	9	*
245	2	M	62	8	T	201	17	C	82	9	*
272	2	M	68	8	T	14	16	CEM	187	9	C
16	1	CEM	164	8	*	65	16	T	205	9	*
34	1	CT	165	8	*	97	16	M	212	9	*
62	1	T	35	7	CT	99	16	M	21	8	CT
65	1	T	101	7	E	100	16	M	80	8	*
68	1	T	158	7	E	104	16	E	173	8	*
70	1	T	183	7	*	106	16	E	203	8	*
100	1	M	218	7	*	200	16	C	83	7	*
105	1	E	4	6	*	233	16	CE	210	7	*
164	1	*	66	6	T	234	16	CE	41	6	CST
165	1	*	103	6	E	64	15	T	79	6	*
247	1	M	106	6	E	66	15	T	253	6	MST
27	0	T	27	5	T	69	15	T	19	5	CT
28	0	T	30	5	T	105	15	E	20	3	CT
29	0	T	104	5	E	237	15	CE	49	3	T
30	0	T	247	5	M	238	14	CE	73	3	*
35	0	CT	65	4	T	247	14	M	215	3	*
101	0	E	105	4	E	28	11	T	72	2	*
102	0	E	221	4	*	71	9	*	169	2	*
103	0	E	29	2	T	73	9	*	71	1	*
104	0	E	70	2	T	78	8	*	74	1	*
106	0	E	28	1	T	74	5	*	78	1	*

LEGEND:

Column # = Card number of sort, from 1 to 278.

Column _f_ = Frequency of choice, from high of 69 to low of 0.

Column _c_ = Code assigned to card item, as follows:

* = Common core element,

C = Civil/Municipal specialization,

E = Electrical/Electronic specialization.

M = Mechanical specialization,

S = Structural specialization,

T = Topographic specialization.

C, E, M, S, T are shown singly or in combination, as applicable.

CHAPTER 5

SUMMARY AND CONCLUSIONS

SUMMARY

THE PROBLEM AND PURPOSE RESTATED

The existing problem of curriculum development and revision gave the impetus for the present study. It was felt that the conventional channels of information input, such as by advisory committee members and by staff returning from a period of renewed industrial experience, should be supplemented by a survey of graduates of the program to obtain their opinions as to the relevancy of curricular items to their jobs.

FINDINGS REGARDING ABSTRACT, NEUTRAL AND APPLICATION ITEMS

In the course of the analysis, as reported in Chapter 4, comparing the perceptions of instructors with those of graduate supervisors and supervisees, and of all graduates, as well as comparing the perceptions of supervisors with those of supervisees (hypotheses 1 to 6), the following has been found:

There were no significant differences among the groups compared in the areas classified as "essential" and "somewhat related", indicating general agreement between instructors and graduates. There was some disagreement in the item responses classified as "related" (hypotheses 1 to 3) and "unrelated" (hypotheses 1 to 4).

When comparing the perceptions of graduates with four or more years of experience with those of graduates with three or fewer years on the job following graduation, it was established that these time and experience factors did not sufficiently influence the item responses as had been hypothesized (hypothesis 5).

It was also shown that application items did not carry consistently higher ranking than abstraction or neutral items combined, rejecting hypothesis 6. It may be deduced, therefore, that, contrary to the researcher's expectations that practitioners would generally place more value in practical skill aspects than in knowledge items, a more balanced view was held by graduates and by instructors.

FINDINGS REGARDING
FIELDS OF SPECIALIZATION

Five major areas of specialization open to graduates of this program were identified, and curriculum items of a specialized nature were classified accordingly. It was found that in three of these five fields of specialization, graduates employed therein would tend to rank more of their own specialty items as "essential" than would graduates working in other areas. The two exceptions occurred in the electrical/electronic and topographic fields of specialization where little differences were found to separate specialists from non-specialists.

At the other end of the continuum, i.e., in the ranking of specialty items as "unrelated", again three fields emerged in which fewer specialists would rank their own items as "unrelated" than would all others. Here the exceptions occurred with regard to the civil/municipal and topographic fields where little differences were found. The comparison, in tabular form, is as follows:

TABLE 5.1 RATING SPECIALTY ITEMS AS "ESSENTIAL"

	% of item responses by specialists:	% of item responses by all others:	Difference in %	
Civil/Municipal	28.2	13.7	14.5	> 10
Electrical/Electronic	12.3	4.0	8.3	< 10
Mechanical	14.4	7.3	27.1	> 10
Structural	41.8	8.9	32.9	> 10
Topographic	20.3	19.0	1.3	< 10

TABLE 5.2 RATING SPECIALTY ITEMS AS "UNRELATED"

	% of item responses by specialists:	% of item responses by all others:	Difference in %	
Civil/Municipal	41.5	47.5	6.0	< 10
Electrical/Electronic	50.9	70.5	19.6	> 10
Mechanical	17.7	63.2	45.5	> 10
Structural	17.3	50.5	33.2	> 10
Topographic	49.1	42.4	6.7	< 10

FINDINGS REGARDING THE CORE CURRICULUM

Similar to the foregoing identification of specialization items of the curriculum, those thought to form a common base for all practitioners of engineering design and drafting technology, were isolated and ratings by the groups of respondents were compared. It was found that supervisors more closely agreed with instructors than both these groups do with supervisees. The following table illustrates the point. It also shows that there is no significant difference between any of the groups in the ranking of items under the heading "somewhat related". The figures are derived from tables 4.12 to 4.15.

TABLE 5.3 RATING COMMON CORE ITEMS

	Essential & Related	Somewhat related	Unrelated
Instructors	51.2%	25.3%	23.5%
Supervisors	50.6	22.8	26.6
Supervisees	37.0	24.1	38.9
All graduates	41.5	23.7	34.8

ADDITIONAL DESCRIPTIVE DATA BASED ON FREQUENCY RANK ORDER

It has been the central purpose of this study to isolate curriculum items in need of revision, or possibly deletion while confirming the importance of others. For this purpose all items have been rank-ordered by four categories based on, but not duplicating, the card sort choices. For the purposes of the rank order, all items under the headings "essential" and "unrelated" were so used, while "essential" and "related", and "related" and "somewhat related" were each combined in separate columns, so as to compensate for individual differences in judgment among respondents.

The reader is referred to Appendix D which offers the complete wording of each of the 278 cards in the sort and grouped by generality or by specialty. Each entry is headed also by the card number, a notation whether the item is abstract, neutral or application, the frequency count for all four categories mentioned above: essential, essential/related, related/somewhat related, and unrelated. These figures are followed by a cumulative scale value (CSV), arbitrarily derived by multiplying essential by 4, essential/related by 3, related/somewhat related by 2, and unrelated by 1. Thus cumulative scale values are arrived at, ranging from a high of 475 to a low of 85. These are designed as the essential guide posts of the study for the revision of individual curriculum items. Low values, therefore, represent areas of concern to the educator responsible for the program. At the end of each heading is shown the quartile based on the cumulative scale values into which each individual item falls. Thus "q:4" means the fourth quartile or a high ranking item, while "q:1", followed by three asterisks in the margin, draws attention to low ranking items, suggesting knowledges or skills judged by the respondents as infrequently required or not required at all, and therefore bear scrutiny on the part of the person charged with curriculum revision. These items, deserving of attention, are extracted and reported on as follows:

CARD SORT ITEMS RANKING IN FIRST QUARTILE, DEEMED INSUFFICIENTLY ENDORSED AND, THEREFORE, RECOMMENDED TO BE REVIEWED, REVISED OR REPLACED:

Whereas in some subject areas (Hydraulics, Topographic Drafting, Mechanical Drafting, Structural Drafting, Modern Drafting Techniques, Materials of Construction, Statics, Properties of Materials, Surveying and Machine Shop) none of the curricular items were rated so low as to fall into the first quartile, the following items, grouped by subject area, were insufficiently endorsed, and are, therefore, recommended for review, revision or replacement:

DESCRIPTIVE GEOMETRY:

Item 004: Strike and dip of a vein of ore, and ore outcrop. There were no respondents found working in mining or geology. Only three respondents found this knowledge to be essential.

Item 005: Graphical vector analysis. Only three respondents regarded this as essential; the great majority found no application for it.

HEATING, VENTILATING AND AIR CONDITIONING:

Items 012, 013, 014, 015, 016, 017, 018:

Although it had been expected that a sufficient number of respondents from the civil, electrical and mechanical fields of specialization would make use of the knowledges contained in these items, none were rated higher than the first quartile, with "essential" ranging from one to six of the seventy-one respondents. This entire subject area should, therefore, be subjected to close scrutiny.

GEOLOGICAL DRAFTING:

Items 027, 028, 029, 030, 031, 032:

All six items were rated low, ranging from zero to five of the seventy-one respondents. They represent knowledge of historical and physical geology, determination of geological age, and geophysical exploration, and the skills involved in interpreting or preparing geological maps and other geological/geophysical drawings. Again this may be due to the fact that no graduates could be located who were employed in this particular field. It is suggested that instruction in this specialized area be relegated to an elective course.

AERIAL PHOTO INTERPRETATION:

Items 034 and 035: Flight planning. One and zero "essential" responses respectively, indicating that none of the graduates surveyed ever became involved in planning flight paths for future aerial surveys. Similarly, item 038: Use of sophisticated plotting methods (such as the Kelch plotter) received a low three "essential" from the respondents, indicating that but few graduates seek or find employment in that area.

LEGAL SURVEY REGULATIONS:

Item 053: Doing work governed by Wellsite Survey Regulations. Unlike all other items pertaining to survey regulations, and the bulk of legal survey theory and practice, this item received a low response of four "essential". It is recommended that less emphasis be placed on this item.

CARTOGRAPHY:

Items 058, 059, 060, 061, 062, 064, 065, 066, 068, 069, 070: eleven of thirteen items were ranked low, ranging from one to five rated "essential". These descriptions were taken from the Algonquin College calendar because Cartography has not been taught at N.A.I.T. to date. Therefore, the graduates surveyed had not had such instruction during their student years and, judging by their responses, had not been called on to perform such duties. They rejected all content except the use of simple stereographic instruments (Item 067) and applying cartographic drawing practices to the production of maps (Item 063).

MACHINE DRAFTING:

Item 100: Using Fogle's Tables. Rejected with a low of one "essential" of 71 responses.

BUILDING SERVICES DRAFTING:

Items 101, 102, 103, 104, 105, 106, 107:
All seven items were rejected, ranging from zero to three "essential". They included air conditioning load analyses, conditioning loads, equipment selection, mechanical refrigeration, and air distribution. It is recommended that this area be closely reviewed and that possible changes be discussed with the members of the Advisory Committee.

ARCHITECTURAL DRAFTING:

Item 150: Making reference to "Standard on Architectural Drawing Practice". Received a low of four "essential" responses, as the only one of fifteen items so ranked. It is suggested, therefore, that this judgment be disregarded.

ELECTRICAL AND ELECTRONIC DRAFTING:

Item 155: Designing electrical systems (four "essential" responses), Item 156: Referring to Canadian Electrical Code (four "essential" responses) and Item 158: Vacuum tube circuits (two "essential" responses). Although a substantial number of respondents are working in this field, it appears that they have not been involved in the type of work necessitating such a background. The curricular specialist is, therefore, advised to deemphasize content of this nature.

SKETCHING AND RENDERING:

Items 164 and 165: Work on presentation boards, in ink or in colour. In each instance only one respondent voted "essential". (See comment under "Technical Illustration" below.)

TECHNICAL ILLUSTRATION:

Item 183: Completing drawings on illustration board. Only two of the respondents found this skill "essential". It is suggested that the curricular specialists responsible for Sketching and Rendering and for Technical Illustration review the place of illustration board techniques in industry, and consider discontinuing their use in instruction if their findings substantiate the respondents' doubt in their usefulness. Item 185: Using paste-ups and cut-outs. Only four respondents found use for this particular skill.

MUNICIPAL DRAFTING:

Item 198: Air and water pollution theory (Only two "essential"),

Item 199: Preparing water and/or sewer profiles (Two "essential").

These are the only two of seventeen items taken from the municipal field, receiving such low rating. Any decision regarding revision of these items should be left to the discretion of the curricular specialits.

COMMUNICATION:

Item 208: Preparing and delivering oral reports to large audiences (Two "essential").

Item 214: Oral presentations to technical society audiences (Five "essential").

These were the only two of twelve items under this heading receiving such low rating. This appears to be due to the lower echelon positions held by most respondents; apparently the need to address larger audiences has not arisen for more than indicated above. This investigator is, however, reluctant to recommend discontinuance of such course content because of the distinct possibility of its application in due time.

APPLIED MATHEMATICS:

Items 218 and 221: Using the trigonometric and logarithmic scales on the slide rule (four and two "essential" respectively). It appears that problem solutions are now more likely achieved by the use of electronic equipment rather than the slide rule.

Item 224: Working statistics (Only four "essential"). Seemingly, of the respondents surveyed, few ever were called on to reduce raw data to usable form, to calculate mean and standard deviation, to use sampling techniques, or to establish significance and probability.

APPLIED PHYSICS (HEAT AND ELECTRICITY):

Items 232, 233, 234, 236, 237, 238, 239, 240;

Although many respondents are actively employed in the electrical field, eight of the twelve items taken from this subject area rated low, ranging from two to six "essential". The items listed cover heat transfer, electrical charges, electric energy, electric circuits, magnetic fields, electromotive forces, generators and motors, and alternating current. It is recommended that the course content of the applied physics offering be closely reviewed, both by consulting with the members of the Advisory Committee and by repeated consultation with graduates working in the electrical/electronic industry.

WELDING:

Items 241, 242, 243, 245: Making use of the knowledge of welding shop practices (Ranging from two to three "essential"),

Item 247: Occasionally performing welding operations (one "essential"). The remaining two items taken from this subject area were rated only slightly higher, namely in the second quartile. Welding, as a subject, was taught at N.A.I.T. for a number of years and was then discontinued because of lack of instructional facilities. The items were, however, included in the study to ascertain whether or not a revival of instruction in welding would be desirable. From the results obtained it appears that such instruction is not regarded as necessary.

INDUSTRIAL PRACTICES IN THE PIPE TRADES:

Item 272: Knowing the responsibilities of the plumber, the gasfitter, and the steamfitter (Two "essential").

Item 278: Referring to the plumbing, gasfitting and boiler installation codes (Four "essential"). Recommended to be reviewed by the curricular specialists.

ADDITIONAL DESCRIPTIVE DATA
DERIVED FROM INTERVIEWS

Interview questions directed at eliciting comments and suggestions in addition to the card sort responses, yielded the answers recorded below. These statements are reproduced here only once, regardless of the frequency with which they may have been made. In many instances the same general ideas were expressed in slightly different ways, in other instances it was found that various graduates' comments were diametrically opposed. Although these responses do not lend themselves to statistical evaluation, they are nevertheless included here for the perusal of the reader concerned with program review or revision.

SPECIALIZATION: Although numerous comments were received on the merits of a broad, general program, the call for specialized (option) terms cannot be overlooked. Comments in this regard read as follows:

A general first year drafting program and a specialized second year . . . Option routes for all of the second year. . . Earlier specialization, i.e., beginning in the fifth quarter. . . A graduate year comprising further skill development as well as added knowledge. . .

MORE THAN HERETOFORE: In the "suggest more" category, the following statements were received: More design, not just drafting. . . (opposed by one respondent who stated that design was useless because that was in the realm of the professional engineer rather than the technologist); More structural design. . . More mechanical design. . . More air conditioning and refrigeration design. . . More photogrammetry. . . More survey field work. . . More emphasis on piping drafting. . . More field trips to see actual work operations. . . More survey calculations and use of the Wang calculator. . . More on steel grades and steel testing in the materials course. . . More emphasis on structural and mechanical drafting. . . More academic preparation in electronics. . . More stress on practical aspects. . . More attention to basic drafting skills throughout the entire program (instructors should be more critical in this regard). . . More presentation work. . . More on specification writing. . . More on reproduction machines, drafting aids and equipment, including the repair of drafting machines. . . More emphasis on written and oral communication. . . More freehand lettering and inking practice. . . More emphasis on job interviews. . .

NEW COURSE FIELDS TO BE CONSIDERED were suggested as follows: A course in electrical or electronic technology. . . A course in photography. . . A highway design course. . . A course in reinforced concrete work ("more frequent applications than for steel construction"). . . A course in sewer design. . . A course in structural methods. . . A course in construction methods. . . A course in environmental protection. . . A course in cartography. . . A course in urban planning tied to legal surveying. . . A basic course in computer programming. . . A course in soil analysis, earth quantity calculations and materials of highway construction. . . Evening courses in metric conversion for technologies. . . A course in management of drafting offices or engineering offices. . . Business training. . . How to design a system for information filing and retrieval. . . Put welding course back into the program. . . Put art course back into the program (to learn to achieve pleasing layouts). . .

OTHER SUGGESTIONS AND CRITICISMS:

Communication: impromptu speaking (oral reports) is valuable, lengthy written reports are useless. . . Mathematics and Physics work should be more closely related to industrial applications, e.g., structural problems: how much a beam will hold; stress. . . Stronger emphasis on math relating to surveying. . . Much of physics (as experienced by that respondent) is unrelated to job applications while other topics are dealt with too briefly. . . Bolted connections should be deemphasized while welded connections should be emphasized. . . Actually welding something . . . Quality of technical mathematics, descriptive geometry and hydraulics was good. . . Would like to see intensive practice in technical sketching for communication of ideas and concepts (a daily need) . . . Technical illustration and sketching are good and useful but major projects are not necessary. . . Architectural drafting courses are too repetitious and not necessary for Engineering Design and Drafting graduates; therefore deemphasize architectural drafting and devote more time to mechanical and electrical areas within the curriculum. . . Introduce a "buddy system" with graduates of the program, to provide early liaison with industry and to acquaint students with the job atmosphere.

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

The perceptions of the relevance of knowledge and skill items on the part of instructors and graduate supervisors were similar, although there was less agreement between these two groups and the group of graduate supervisees. The importance of knowledge items was shown equal among practitioners regardless of their spans of experience.

Relatively equal importance was assigned to practical skill items as to knowledge items by all respondents.

Graduates showed a tendency to rank items pertaining to their own field of specialization higher than those of another field, except that items taken from the topographic field were shown of almost equal value to all specialists, and, similarly, in the electrical/electronic field, except that there were noted differences in the category of "unrelated" items.

Instructors and the combined group of graduates, as well as instructors compared with supervisors, agreed on what constitutes essential and related core content of the curriculum. The group of supervisors among the graduates did not agree with the group of supervisees.

Card sort items whose cumulative scale value places them in the fourth quartile are regarded as "strongly endorsed"; those in the third quartile as "endorsed"; those in the second quartile as "sufficiently endorsed" to warrant continued inclusion in the curriculum. Items placed in the first quartile are judged as "insufficiently endorsed", and should be reviewed, revised or replaced. Most of the recommendations stated on pages 74 and 75 are based on these first quartile items.

The additional descriptive data derived from the interviews are included as important information. No attempt has been made to evaluate these.

A suggestion repeatedly made in the course of the interviews, to offer an entire second year of specialized routes, or to at least make all of the fifth and sixth quarters (of the six-quarter program) elective, cannot be included among the recommendations of this study, as no conclusive evidence for or against such program reorganization could be obtained within the scope of the present research.

The following recommendations are presented:

(A) Where in the listing of courses or subject areas (pp. 64 to 69) only isolated items received a low cumulative scale value, these items are to be revised or replaced.

(B) Where in the listing a majority of items received such low rating, the following changes to existing courses shall be carried out:

1 APPLIED PHYSICS:

Revise the entire course. The low ratings (pp. 97 to 99) given to all content of the present course "Heat and Electricity" and the higher ratings obtained in the mechanical area indicate that a new course should be offered: "Applied Mechanics", comprising: types of motion - speed, velocity, acceleration, angular motion; laws of motion; energy, power, torque, impulse and momentum.

2 HEATING, VENTILATING AND AIR CONDITIONING:

Reschedule the course as an option. The low ratings (pp. 96 to 97) indicate the limited area of employment where this knowledge can be applied by graduates of this program. The course should, however, be maintained to satisfy the requirements of sixth quarter students expecting employment in a related field.

3 BUILDING SERVICES DESIGN AND DRAFTING:

Reschedule the course as an option. The low ratings (pp. 101 to 102) are the basis for the same recommendation as in #1 above.

4 GEOLOGICAL DRAFTING:

Reschedule the course as an option. The low ratings (p. 113) are the basis for the same recommendation as in #1 above.

5 AERIAL PHOTO INTERPRETATION:

Remove flight planning exercises and do not use sophisticated stereo-plotters (p. 100). Instead, devote more time to interpretation of imagery and the transfer of information from photos to drawings (p. 70).

6 SKETCHING AND RENDERING:

Remove drawing techniques involving illustration boards (p. 90), instead enlarge on freehand sketching skill development (p. 72).

7 TECHNICAL ILLUSTRATION:

Reschedule as an option, and omit major presentation work using illustration boards (pp. 67 & 91).

8 WELDING:

Low ratings (p. 105) indicate that this course should not be re-introduced.

9 CARTOGRAPHY:

Low ratings (pp. 115 to 116) indicate that this course should not be introduced.

10 OFFICE MANAGEMENT AND PERSONNEL SUPERVISION:

Devise and offer such an option course. (Many interview responses indicated a need for instruction in this area.)

The foregoing recommendations are incorporated in Figure 5.1 below (see Appendix C, p. 86, for comparison with the existing structure). Quarters 1 and 2 have been omitted in the figure, as there is only one minor change (recommendation 6) affecting a 2nd quarter course.

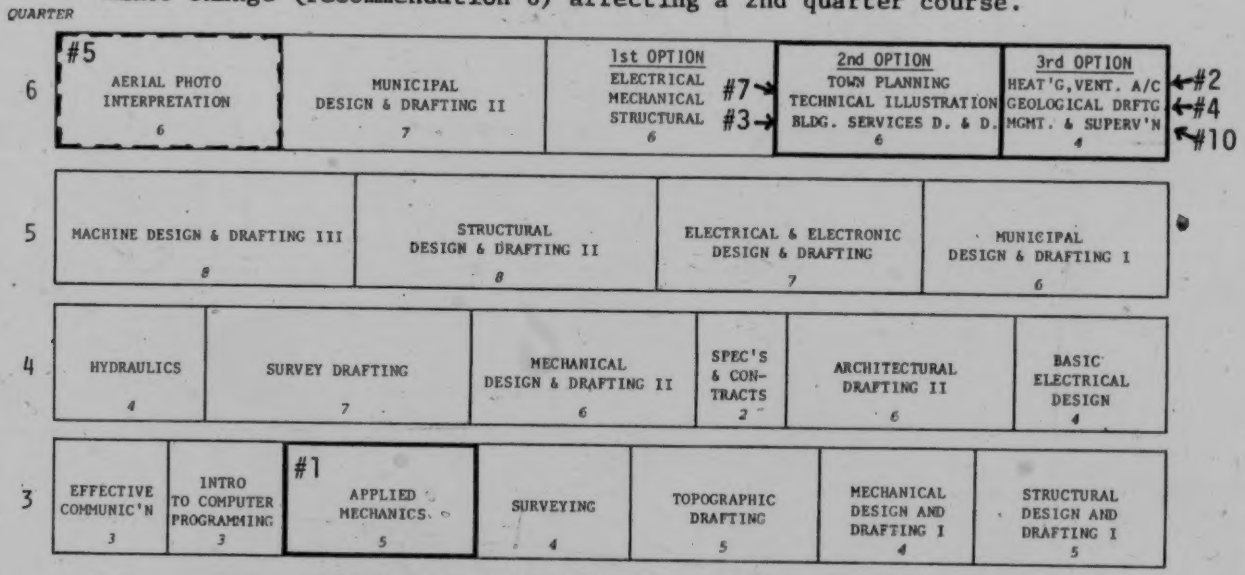
QUARTER
6
#5
AERIAL PHOTO INTERPRETATION 6
MUNICIPAL DESIGN & DRAFTING II 7
1st OPTION
ELECTRICAL MECHANICAL STRUCTURAL 6
#7
#3
2nd OPTION
TOWN PLANNING
TECHNICAL ILLUSTRATION
BLDG. SERVICES D. & D. 6
3rd OPTION
HEAT'G, VENT. A/C
GEOLOGICAL DRFTG
MGMT. & SUPERV'N 4
#2
#4
#10
5
MACHINE DESIGN & DRAFTING III 8
STRUCTURAL DESIGN & DRAFTING II 8
ELECTRICAL & ELECTRONIC DESIGN & DRAFTING 7
MUNICIPAL DESIGN & DRAFTING I 6
4
HYDRAULICS 4
SURVEY DRAFTING 7
MECHANICAL DESIGN & DRAFTING II 6
SPEC'S & CONTRACTS 2
ARCHITECTURAL DRAFTING II 6
BASIC ELECTRICAL DESIGN 4
3
EFFECTIVE COMMUNIC'N 3
INTRO TO COMPUTER PROGRAMMING 3
#1
APPLIED MECHANICS 5
SURVEYING 4
TOPOGRAPHIC DRAFTING 5
MECHANICAL DESIGN AND DRAFTING I 4
STRUCTURAL DESIGN AND DRAFTING I 5

FIGURE 5.1 RECOMMENDED PROGRAM CHANGES

From the present research, it can be stated that the program investigated is worthwhile. This judgment is based on the fact that of 258 curriculum items (excluding 20 items in welding and cartography not in the program), 69 (27%) were rated in the 4th (highest) quartile, 70 (27%) in the 3rd, and 67 (26%) in the 2nd quartile. There were reservations against 52 (20%) items rated in the first (lowest) quartile.

As a major benefit derived from graduation from this program, 59 (98.3%) of 60 graduates stated that their diploma aided them in the area of promotion, and only 1 (1.7%) responded in the negative. The question *"was there anything lacking in the NAIT program which would have been of benefit in regard to advancement?"* was answered with YES (and commented on) by 16 (26.7%), and with NO by 44 (73.3%) of the graduates surveyed. (See item 9, Appendix F, p. 118.)

RECOMMENDATIONS FOR FURTHER RESEARCH

In this section a procedure is proposed for the study of curriculum perceptions by practicing graduates at recurring intervals of time. Although the following is based on the present study, and is suggested with a view of providing industry feedback for the Engineering Design and Drafting Technology curriculum as administered through the Northern Alberta Institute of Technology, it may well serve as a guide for studies of other technologies at the same or at another institution.

Identification of potential respondents:

A difficulty encountered with this study was in locating the graduates from this N.A.I.T. program. The ideal would be the identification of the total population, in the case of the present study physically locating all those who graduated from the program since 1965. Of a potential 274 graduates, only 136 could be identified as to their places of residence, or employment, or both. Although even under these conditions a representative sample of 60 graduates could be contacted, it is suggested that program heads at institutes of technology, or colleges, make every effort to maintain a file of graduates, and constantly encourage alumni of their programs to communicate with their institute, especially as regards changes of employment and promotions.

The selection of respondents to future studies should again be made randomly, and proportionate to the number of graduates employed within the various fields of specialization so as to apply equalizing weighting to the concerns of these sub-populations. In this context it must be recognized that the areas of specialization dealt with in this study (i.e., Civil/Municipal, Electrical/Electronic, Mechanical, Structural, and Topographic) are not supplied by equal numbers of graduates. This fact underscores the importance of maintaining an up-to-date file of the graduates' professional careers, as stated in the first paragraph above.

Identification of data:

Based on the results of this study, the data required for future studies should be drawn from course outlines as existent at that time, and from potential course content known or thought to be of value to industry. Some allowance should be made for respondents to add information on knowledges and skills frequently required on the job but not covered by the survey instrument.

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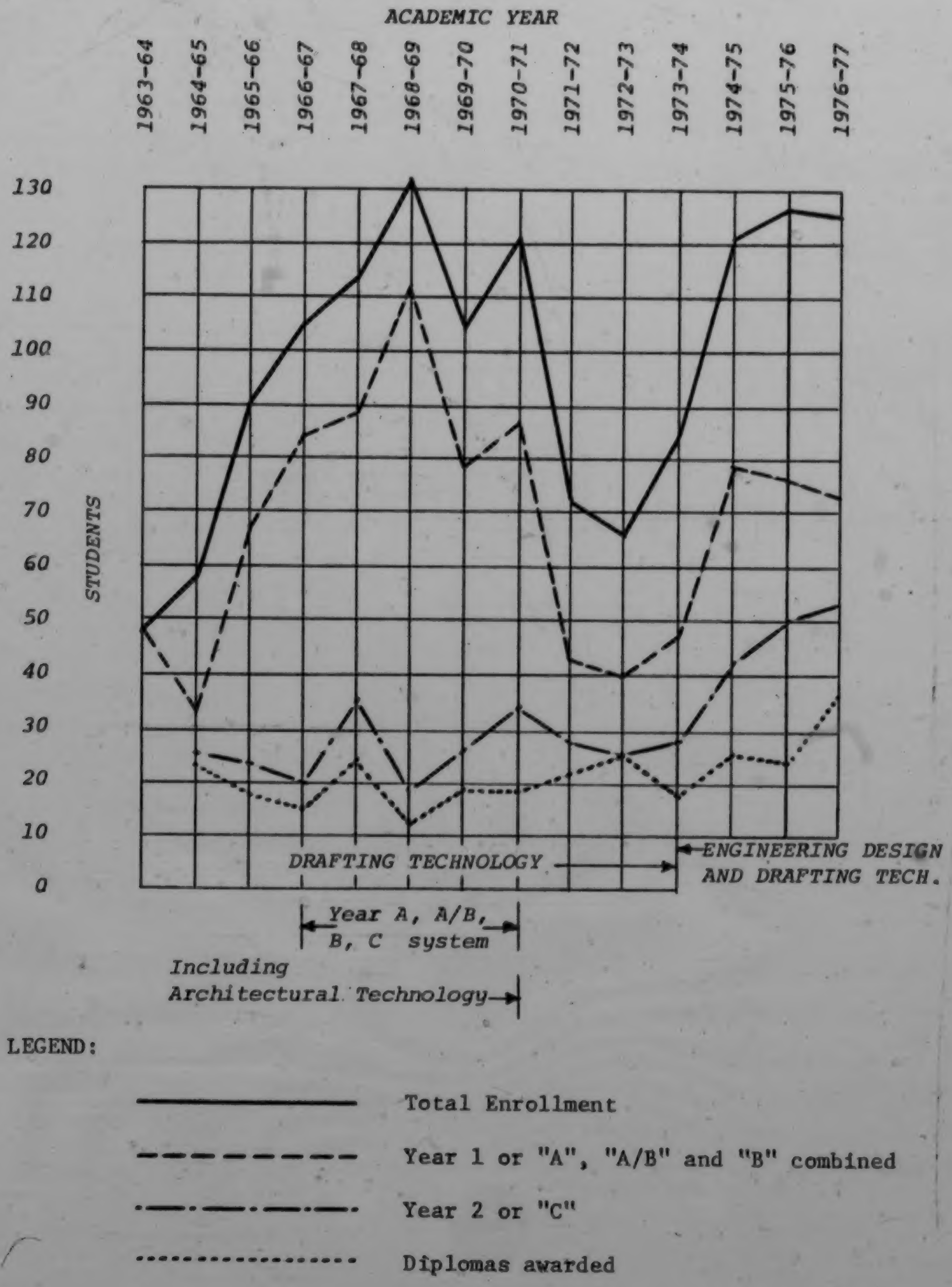
APPENDICES

ENROLLMENT FIGURES, N.A.I.T. REGISTRAR'S OFFICE Appendix A
SUMMARY OF STUDENT EMPLOYMENT SURVEY, N.A.I.T. Appendix B
PROGRAM OVERVIEW, ENGINEERING DESIGN AND DRAFTING TECHNOLOGY Appendix C
CARD SORT CONTENT Appendix D
SAMPLE QUESTIONNAIRE Appendix E
SAMPLE INTERVIEW SCHEDULE Appendix F
SAMPLE COMMENT FORM Appendix G
CLASSIFICATION OF CARD CONTENT FOR HYPOTHESES 1 - 6 Appendix H
CLASSIFICATION OF CARD CONTENT FOR HYPOTHESES 7 - 11 Appendix J
CLASSIFICATION OF CARD CONTENT FOR HYPOTHESES 12 - 15 Appendix K
RESPONDENTS BY FIELD OF SPECIALIZATION Appendix L
SAMPLE CHECK LIST Appendix M
CARD CHOICES: "ESSENTIAL" AND "ESSENTIAL AND RELATED" Appendix N
CARD CHOICES: "RELATED AND SOMEWHAT RELATED" AND "UNRELATED" Appendix O

APPENDIX A: ENROLLMENT FIGURES ACCORDING TO DATA RECEIVED FROM THE REGISTRAR'S OFFICE, N.A.I.T., 1963 - 1976



APPENDIX B

CANADA MANPOWER CENTRE ON CAMPUS
NORTHERN ALBERTA INSTITUTE OF TECHNOLOGY
SUMMARY OF N.A.I.T. STUDENT EMPLOYMENT SURVEY
1974-75 AND 1975-76

Program: ENGINEERING DESIGN AND DRAFTING		1974-75	1975-76
Number of students interviewed for jobs:		32	40
Total number of employment interviews:		171	200
Total no. of stdts. who received empl. offers:		31	40
Total number of employment offers:		63	100
Students who have accepted employment:		31	37
Job related to program of studies:		30	37
Starting salary per month -	Low:	$ 692	$ 800
	High:	$1050	$ 953
	Mean:	$ 825	$ 880
Location of Employment:	Edmonton		
Seeking Employment:			
Right after graduation:		23	
Only after 1 or 2 months holiday:		2	
Not with much effort:		1	
No, returning to school:		6	
No:		1	
Number of responses:		33	
Number expected to graduate:		26	33

EMPLOYER LIST: Northwestern Utilities Ltd.; Fibreglass Canada Ltd.; Underwood McLellan & Assoc.; Gov't of Alberta; Edmonton Power; City of Edmonton; BACM Industries; Tottrup & Assoc.; Northern Canada Power Commission; Reed, Jones & Christofferson; Gov't of Canada; Alberta Gov't Telephones; Alberta Gas Trunk Line; McBride Regan Sorenson Consultants; Bowen & Field; Edmonton Alta. Tech. Services; Read, Crowthers, Partners; Canadian Bechtel.

APPENDIX C: PROGRAM OVERVIEW BY YEAR AND QUARTER

ENGINEERING DESIGN & DRAFTING TECHNOLOGY - 1976/77

	QUARTER									HRS / WEEK HRS	TOTAL
YEAR 2	6	DT 630 SURVEY DRAFTING 7	DT 640 BUILDING SERVICES DESIGN & DRAFTING 6	DT 680 TECHNICAL ILLUSTR'N 3	DT 690 MUNICIPAL DESIGN & DRAFTING II 6	OPTION DT 650, 661, 670, 691 Structural, Mechanical, Elect'l or Town Pl'ng 6				28	336
	5	DT 520 HEATING, VENTILATING & AIR CON'G 3	DT 540 MACHINE DESIGN & DRAFTING III 8	DT 550 STRUCTURAL DESIGN & DRAFTING II 7	DT 570 ELECTRICAL & ELECTRONIC DESIGN & DRAFTING 6	DT 590 MUNICIPAL DESIGN & DRAFTING I 5				29	348
	4	DT 420 HYDRAULICS 4	DT 430 GEOLOGICAL DRAFTING 3	DT 431 AERIAL PHOTO INTERPRETATION 5	DT 440 MECHANICAL DESIGN & DRAFTING II 6	DT 460 SPEC'S & CONTRACTS 2	DT 461 ARCHITECTURAL DRAFTING II 6	DT 470 BASIC ELECTRICAL DESIGN 3		29	348
YEAR 1	3	ASE 360 EFFECTIVE COMMUNIC'N 3	ASM 380 INTRO TO COMPUTER PROGRAMMING 3	ASP 316 HEAT AND ELECTRICITY 5	CT 327 SURVEYING 4	DT 330 TOPOGRAPHIC DRAFTING 5	DT 340 MECHANICAL DESIGN AND DRAFTING I 4	DT 350 STRUCTURAL DESIGN AND DRAFTING I 5		29	348
	2	ASE 250 EFFECTIVE COMMUNIC'N 3	ASM 210 TECHNICAL MATHEMATICS 4	MT 208 PROPERTIES & STRENGTHS OF MATERIALS 5	IP 203 MACHINE SHOP 5	DT 260 ARCHITECTURAL DRAFTING I 6	DT 280 PERSPECTIVE DRAWING, SKETCHING AND RENDERING 6			29	348
	1	ASE 140 EFFECTIVE COMMUNIC'N 3	ASM 109 TECHNICAL MATHEMATICS 5	CON 104 MATERIALS OF CONSTRUCTION 4	CT 117 STATICS 4	DT 110 DESCRIPTIVE GEOMETRY 5	DT 140 MECHANICAL DRAFTING I 8			29	348
											2076

APPENDIX D: CARD SORT CONTENT

All curriculum items used in the sort are listed on pages 87 to 115. They are grouped by course or subject area indicated by the caption above each description of a knowledge or skill. Captions are in turn preceded by a code line, as explained hereunder:

First entry: same as in Table 4.16 and explained on page 59, viz.,

* = Common core element,
C = Civil/Municipal specialization,
E = Electrical/Electronic specialization,
M = Mechanical specialization,
S = Structural specialization,
T = Topographic specialization.

C, E, M, S, T appear singly or in combination.

Second entry: card sort item number, ranging from 001 to 278.

Third entry: frequency (f:) with which the particular item was chosen, and recorded as follows:

ESS = "essential",
E/R = combined "essential" and "related",
RSR = combined "related" and "somewhat related",
UNR = "unrelated".

Fourth entry: cumulative scale value (csv:), derived by calculation as described on page 63, it is the product of multiplying ESS by 4, E/R by 3, RSR by 2 and UNR by 1.

Fifth entry: quartile (q:) into which the cumulative scale values shown are falling, i.e., the first, second, third or fourth quartile. In the case of first quartile (lowest) ratings three asterisks (***) are printed in the margin to draw attention to these items.

* 001 NEUT f: ESS 15 E/R 31 RSR 40 UNR 16 csv: 249 q:3

GRAPHICS BY DESCRIPTIVE GEOMETRY:
Finding the true length and slope of a line; the true slope and size of a plane; the bearing and slope of a line of given length.

* 002 NEUT f: ESS 15 E/R 29 RSR 41 UNR 15 csv: 244 q:3

GRAPHICS BY DESCRIPTIVE GEOMETRY:
Finding the perpendicular distance from a point to a given line; the shortest distance between two lines; the shortest line of given slope between two lines.

* 003 NEUT f: ESS 9 E/R 22 RSR 40 UNR 22 csv: 204 q:3

GRAPHICS BY DESCRIPTIVE GEOMETRY:
Finding the point where a line pierces a plane; finding the angle a line makes with a plane; finding a line perpendicular to a plane; finding the dihedral angle; finding the intersection of two planes.

* 004 NEUT f: ESS 3 E/R 6 RSR 17 UNR 51 csv: 115 q:1 ***

GRAPHICS BY DESCRIPTIVE GEOMETRY:
Finding the strike and dip of a vein of ore; determining the line of outcrop of a vein or stratum.

* 005 ABST f: ESS 3 E/R 11 RSR 20 UNR 48 csv: 133 q:1 ***

GRAPHICS BY DESCRIPTIVE GEOMETRY:
Making applications of Graphical Vector Analysis: concurrent coplanar force systems; concurrent non-coplanar force systems.

* 071 APPL f: ESS 61 E/R 68 RSR 9 UNR 1 csv: 467 q:4

FUNDAMENTAL GRAPHICS:
Doing freehand lettering in pencil.

* 072 APPL f: ESS 44 E/R 63 RSR 25 UNR 2 csv: 417 q:4

FUNDAMENTAL GRAPHICS:
Doing freehand lettering in ink.

* 073 APPL f: ESS 59 E/R 65 RSR 9 UNR 3 csv: 452 q:4

FUNDAMENTAL GRAPHICS:
Doing mechanical lettering in ink, using such instruments as Leroy, Wrico, Alpha, Doric, etc.

* 074 APPL f: ESS 65 E/R 68 RSR 5 UNR 1 csv: 475 q:4

FUNDAMENTAL GRAPHICS:
Doing drafting, using geometric constructions (straight and curved lines, circles, ellipses, involutes, polygons, tangents, etc.)

* 075 APPL f: ESS 44 E/R 54 RSR 17 UNR 10 csv: 382 q:4

FUNDAMENTAL GRAPHICS:
Doing drafting, using multiview projection (e.g., mechanical top, front, and side views, or architectural floor plan and elevations).

* 076 APPL f: ESS 18 E/R 35 RSR 38 UNR 15 csv: 268 q:4

FUNDAMENTAL GRAPHICS:
Doing drafting using convergent projection (e.g., perspective drawings).

* 077 APPL f: ESS 25 E/R 42 RSR 37 UNR 9 csv: 309 q:4

FUNDAMENTAL GRAPHICS:
Doing technical freehand sketching.

* 078 APPL f; ESS 62 E/R 69 RSR 8 UNR 1 csv: 472 q:4

FUNDAMENTAL GRAPHICS:
Dimensioning drawings.

* 079 APPL f: ESS 47 E/R 58 RSR 18 UNR 6 csv: 404 q:4

FUNDAMENTAL GRAPHICS:
Drawing sectional views.

* 080 APPL f: ESS 23 E/R 43 RSR 40 UNR 8 csv: 309 q:4

FUNDAMENTAL GRAPHICS:
Using the techniques of descriptive geometry.

* 081 APPL f: ESS 16 E/R 31 RSR 35 UNR 20 csv: 247 q:3

FUNDAMENTAL GRAPHICS:
Doing developments and intersections (prisms, cylinders, cones; transition pieces).

* 082 APPL f: ESS 30 E/R 47 RSR 32 UNR 9 csv: 334 q:4

FUNDAMENTAL GRAPHICS:
Reproducing drawings by the Diazo (or Ozalid) process.

* 083 NEUT f: ESS 32 E/R 50 RSR 32 UNR 7 csv: 349 q:4

FUNDAMENTAL GRAPHICS:
Having a working knowledge of (but NOT actually performing) the reproduction of drawings by the Diazo (or Ozalid) process.

* 162 APPL f: ESS 8 E/R 22 RSR 34 UNR 29 csv: 195 q:3

SKETCHING AND RENDERING:
Doing perspective sketching and rendering in pencil.

* 163 APPL f: ESS 4 E/R 18 RSR 32 UNR 35 csv: 169 q:2

SKETCHING AND RENDERING:
Doing perspective drafting employing shades and shadows, using pencil and ink.

* 164 APPL f: ESS 1 E/R 8 RSR 23 UNR 47 csv: 121 q:1 ***

SKETCHING AND RENDERING:
Making perspective presentation drawings on Bristol board, employing shades, shadows, and rendering techniques in ink.

* 165 APPL f: ESS 1 E/R 8 RSR 21 UNR 49 csv: 119 q:1 ***

SKETCHING AND RENDERING:
Making perspective presentation drawings on Bristol board, employing shades and shadows, and rendering techniques in colour.

* 166 ABST f: ESS 17 E/R 44 RSR 44 UNR 10 csv: 298 q:4

MODERN DRAFTING TECHNIQUES:
Being familiar with but NOT performing: photographic reproduction processes, and photo drafting; micro-filming; electrostatic processes.

* 167 APPL f: ESS 4 E/R 17 RSR 42 UNR 25 csv: 176 q:2

MODERN DRAFTING TECHNIQUES:
Carrying out reproduction by: photographic processes; electrostatic processes; micro-filming; and doing photo drafting.

* 168 APPL f: ESS 8 E/R 19 RSR 31 UNR 32 csv: 183 q:2

MODERN DRAFTING TECHNIQUES:
Working with acetate and polyester films, and with scribe coat and peel coat.

* 169 APPL f: ESS 27 E/R 55 RSR 42 UNR 2 csv: 359 q:4

MODERN DRAFTING TECHNIQUES:
Using "stick-ons" on drawings: lettering, symbols, various backgrounds, tapes, etc.

* 170 APPL f: ESS 5 E/R 17 RSR 27 UNR 39 csv: 164 q:2

MODERN DRAFTING TECHNIQUES:
Performing computer drafting.

* 171 APPL f: ESS 26 E/R 46 RSR 35 UNR 10 csv: 322 q:4

MODERN DRAFTING TECHNIQUES:
Preparing drawings for micro-filming.

* 172 APPL f: ESS 10 E/R 26 RSR 34 UNR 27 csv: 213 q:3

MODERN DRAFTING TECHNIQUES:
Preparing drawings for photo fabrication.

* 173 APPL f: ESS 22 E/R 44 RSR 41 UNR 8 csv: 310 q:4

MODERN DRAFTING TECHNIQUES:
Preparing graphs and charts.

* 174 APPL f: ESS 7 E/R 21 RSR 32 UNR 32 csv: 187 q:2

TECHNICAL ILLUSTRATION:
Preparing production illustrations.

* 175 APPL f: ESS 5 E/R 16 RSR 28 UNR 38 csv: 162 q:2

TECHNICAL ILLUSTRATION:
Preparing promotion illustrations.

* 176 APPL f: ESS 13 E/R 24 RSR 39 UNR 19 csv: 221 q:3

TECHNICAL ILLUSTRATION:
Using drafting skills in technical illustration.

* 177 APPL f: ESS 7 E/R 17 RSR 38 UNR 26 csv: 181 q:2

TECHNICAL ILLUSTRATION:
Using artistic skills in technical illustration.

* 178 APPL f: ESS 9 E/R 23 RSR 35 UNR 27 csv: 202 q:3

TECHNICAL ILLUSTRATION:
Using techniques of pictorial drawing (axonometric, oblique, perspective) for the purposes of technical illustration.

* 179 APPL f: ESS 14 E/R 26 RSR 30 UNR 27 csv: 221 q:3

Using multi-view (including sectional) drawings for the purposes of technical illustration.

* 180 APPL f: ESS 12 E/R 26 RSR 26 UNR 33 csv: 211 q:3

TECHNICAL ILLUSTRATION:
Preparing pencil drawings and sketches for the purposes of technical illustration.

* 181 APPL f: ESS 5 E/R 15 RSR 26 UNR 40 csv: 157 q:2

TECHNICAL ILLUSTRATION:
Rendering in ink for the purposes of technical illustration.

* 182 ABST f: ESS 6 E/R 15 RSR 25 UNR 40 csv: 159 q:2
TECHNICAL ILLUSTRATION:
Making use of the knowledge of functional and aesthetic layout (simplicity, proportion, harmony, rhythm, balance, visual flow) for the purposes of technical illustration.

* 183 APPL f: ESS 2 E/R 7 RSR 26 UNR 43 csv: 124 q:1 ***

TECHNICAL ILLUSTRATION:
Completing drawings on illustration board.

* 184 APPL f: ESS 17 E/R 27 RSR 35 UNR 19 csv: 238 q:3

TECHNICAL ILLUSTRATION:
Completing drawings on material other than illustration board (e.g., tracing paper, tracing cloth, sketch pads, mylar film, etc.).

* 185 APPL f: ESS 4 E/R 11 RSR 29 UNR 38 csv: 145 q:1 ***

TECHNICAL ILLUSTRATION:
Using paste-ups and cut-outs in the preparation of technical illustrations.

* 203 NEUT f: ESS 31 E/R 52 RSR 32 UNR 8 csv: 352 q:4

COMMUNICATION:
Recording information, and collecting data, for subsequent retrieval.

* 204 NEUT f: ESS 32 E/R 48 RSR 28 UNR 11 csv: 339 q:4

COMMUNICATION:
Using efficient methods for finding sources and collecting data.

* 205 NEUT f: ESS 31 E/R 53 RSR 31 UNR 9 csv: 354 q:4

COMMUNICATION:
Selecting, limiting and organizing information pertaining to the job.

* 206 NEUT f: ESS 29 E/R 45 RSR 30 UNR 12 csv: 323 q:4

COMMUNICATION:
Using clarity in choice of words and sentence structure; and brevity without sacrificing meaning, when writing definitions, descriptions of a mechanism or of a process.

* 207 NEUT f: ESS 14 E/R 32 RSR 33 UNR 24 csv: 242 q:3

COMMUNICATION:
Preparing and delivering oral reports to an individual or a small group.

* 208 NEUT f: ESS 2 E/R 11 RSR 21 UNR 48 csv: 131 q:1 ***

COMMUNICATION:
Preparing and delivering oral reports to large audiences.

* 209 NEUT f: ESS 20 E/R 37 RSR 37 UNR 24 csv: 289 q:4

COMMUNICATION:
Writing memoranda, and completing forms.

* 210 NEUT f: ESS 30 E/R 47 RSR 34 UNR 7 csv: 336 q:4

COMMUNICATION:
Being skilled in writing letters of application, and knowing how to conduct oneself in a job interview.

* 211 NEUT f: ESS 22 E/R 38 RSR 38 UNR 11 csv: 289 q:4

COMMUNICATION:
Developing better than average reading skills, so as to increase retention, comprehension and critical appraisal of the material read.

* 212 NEUT f: ESS 24 E/R 45 RSR 38 UNR 9 csv: 316 q:4

COMMUNICATION:
Developing better than average discussion techniques, so as to become more effective in orally communicating on the job, and in one's social and political situations.

* 213 NEUT f: ESS 11 E/R 26 RSR 30 UNR 30 csv: 212 q:3

COMMUNICATION:
Writing technical reports, based on a knowledge of various "best" formats suited to the purpose.

* 214 NEUT f: ESS 5 E/R 11 RSR 25 UNR 41 csv: 144 q:1 ***

COMMUNICATION:
Preparing and delivering oral presentations of a technical report to a technical society audience; using audio/visual aids to effectively illustrate otherwise complex concepts of the talk.

* 215 APPL f: ESS 42 E/R 61 RSR 26 UNR 3 csv: 406 q:4

APPLIED MATHEMATICS:
Using hand calculators for various computations.

* 216 APPL f: ESS 6 E/R 20 RSR 33 UNR 32 csv: 182 q:2

APPLIED MATHEMATICS:
Using the slide rule for multiplication and division.

* 217 APPL f: ESS 6 E/R 16 RSR 31 UNR 34 csv: 168 q:2

APPLIED MATHEMATICS:
Using the slide rule for multiplication, division, combined equations, squares, square roots, cubes and cube roots.

* 218 APPL f: ESS 4 E/R 7 RSR 24 UNR 43 csv: 128 q:1 ***

APPLIED MATHEMATICS:
Using the trigonometric scales on the slide rule.

* 219 NEUT f: ESS 6 E/R 18 RSR 36 UNR 29 csv: 179 q:2

APPLIED MATHEMATICS:
Making use of vectors.

* 220 NEUT f: ESS 6 E/R 18 RSR 31 UNR 34 csv: 174 q:2

APPLIED MATHEMATICS:
Making use of exponents and radicals.

* 221 APPL f: ESS 2 E/R 4 RSR 19 UNR 50 csv: 108 q:1 ***

APPLIED MATHEMATICS:
Using the logarithmic scales on the slide rule.

* 222 ABST f: ESS 10 E/R 28 RSR 41 UNR 20 csv: 226 q:3

APPLIED MATHEMATICS:
Making use of plane analytic geometry.

* 223 NEUT f: ESS 11 E/R 35 RSR 45 UNR 15 csv: 254 q:4

APPLIED MATHEMATICS:
Making use of variation (ratio and proportion).

* 224 NEUT f: ESS 4 E/R 11 RSR 28 UNR 39 csv: 144 q:1 ***

APPLIED MATHEMATICS:
Working statistics: reducing raw data to usable form; calculating mean and standard deviation; locating the distribution; using sampling techniques; establishing significance, probability.

* 225 NEUT f: ESS 9 E/R 27 RSR 36 UNR 26 csv: 215 q:3

APPLIED MATHEMATICS:
To understand basic concepts of computing and of computer capabilities, so that simple programs can be written, punched and run on a computer.

* 226 NEUT f: ESS 7 E/R 13 RSR 24 UNR 40 csv: 155 q:2

APPLIED MATHEMATICS:
Using computer unit record machines such as key-punch, verifier, sorter, collator and tabulators.

* 227 ABST f: ESS 7 E/R 17 RSR 34 UNR 30 csv: 177 q:2

APPLIED MATHEMATICS:
Knowing the operation of a computer: storage devices, central processing unit, input-output devices, and teleprocessing.

* 228 NEUT f: ESS 5 E/R 14 RSR 29 UNR 37 csv: 157 q:2

APPLIED MATHEMATICS:
Applying the knowledge of computer real-time systems, stored program concepts, binary arithmetic, programming systems, machine coding, compliers and assemblers, decision tables and the Fortran language.

C 186 ABST f: ESS 18 E/R 39 RSR 35 UNR 18 csv: 277 q:4

MUNICIPAL DRAFTING:
Making use of the knowledge of drainage: hydrology; design of ditches; design of culverts.

C 187 ABST f: ESS 29 E/R 48 RSR 33 UNR 9 csv: 335 q:4

MUNICIPAL DRAFTING:
Making use of the knowledge of subdivision planning: legal requirements; zoning; use of legal survey plans.

C 188 NEUT f: ESS 29 E/R 48 RSR 28 UNR 14 csv: 330 q:4

MUNICIPAL DRAFTING:
Making use of the knowlege of design procedures and standards for: street grades; subgrade; wearing surface, etc.; curbs and walks.

C 189 APPL f: ESS 28 E/R 44 RSR 24 UNR 19 csv: 311 q:4

MUNICIPAL DRAFTING:
Preparing drawings showing surface drainage (ditches and culverts), curbs and walks.

C 190 ABST f: ESS 16 E/R 31 RSR 31 UNR 24 csv: 243 q:3

MUNICIPAL DRAFTING:
Making use of the knowledge of storm sewer design: coefficient of runoff, frequency, intensity, area determination, time of concentration.

C 191 ABST f: ESS 19 E/R 34 RSR 27 UNR 25 csv: 257 q:4

MUNICIPAL DRAFTING:
Making use of the knowledge of sewer materials: strength determination of pipes; manholes - normal and special; minimum and maximum velocity.

C 192 ABST f: ESS 25 E/R 37 RSR 31 UNR 15 csv: 288 q:4

MUNICIPAL DRAFTING:
Making use of the knowledge of sewer installation: trenching, laying, backfilling.

C 193 ABST f: ESS 14 E/R 27 RSR 29 UNR 28 csv: 223 q:3

MUNICIPAL DRAFTING:
Making use of the knowledge of waterworks: distribution systems: classified by gravity, distributing reservoirs, pressure; conduits; valves, hydrants and fittings;
estimating quantity required for domestic, commercial/industrial and public purposes; selecting source of supply: surface water and ground water.

C 194 ABST f: ESS 12 E/R 24 RSR 29 UNR 30 csv: 208 q:3

MUNICIPAL DRAFTING:
Making use of the knowledge of water reservoirs: storage reservoirs; distributing reservoirs.

C 195 ABST f: ESS 7 E/R 16 RSR 29 UNR 35 csv: 169 q:2

MUNICIPAL DRAFTING:
Making use of the knowledge of water treatment.

C 196 ABST f: ESS 18 E/R 30 RSR 32 UNR 21 csv: 247 q:3

MUNICIPAL DRAFTING:
Making use of the knowledge of sanitary sewer design: estimating quantity; hydraulics of sewers; slope determinations; pipes (materials, trenching, installation, jointing); manholes.

C 197 ABST f: ESS 5 E/R 17 RSR 33 UNR 33 csv: 170 q:2

MUNICIPAL DRAFTING:
Making use of the knowledge of sewage treatment.

C 198 ABST f: ESS 2 E/R 9 RSR 31 UNR 38 csv: 135 q:1 ***

MUNICIPAL DRAFTING:
Making use of the knowledge of air and water pollution theory.

C 199 APPL f: ESS 2 E/R 9 RSR 31 UNR 38 csv: 135 q:1 ***

MUNICIPAL DRAFTING:
Preparing water and/or sewer profiles.

C 200 APPL f: ESS 28 E/R 34 RSR 16 UNR 27 csv: 273 q:4

MUNICIPAL DRAFTING:
Preparing sanitary sewer design drawings.

C 201 APPL fL ESS 27 E/R 34 RSR 17 UNR 27 csv: 271 q:4

MUNICIPAL DRAFTING:
Preparing storm sewer design drawings.

C 202 APPL f: ESS 18 E/R 30 RSR 22 UNR 31 csv: 237 q:3

MUNICIPAL DRAFTING:
Preparing waterworks design drawings.

CM 006 ABST f: ESS 8 E/R 25 RSR 39 UNR 24 csv: 209 q:3

HYDRAULICS:
Making use of the knowledge of fluid statics: pressure; pressure head; direction of resultant pressure; Pascal's law; atmospheric pressure; gage pressure; absolute pressure; vapor pressure.

CM 007 ABST f: ESS 8 E/R 21 RSR 33 UNR 30 csv: 191 q:3

HYDRAULICS:
Making use of the knowledge of fluid statics: pressure measurement: mercury barometer; piezometer; manometer; pressure gages.

CM 008 ABST f: ESS 6 E/R 20 RSR 37 UNR 28 csv: 186 q:2

HYDRAULICS:
Making use of the knowledge of fluid statics: hydrostatic pressure on surfaces: total force, centre of pressure; horizontal and vertical components; hoop stresses; buoyancy.

CM 009 ABST f: ESS 7 E/R 23 RSR 35 UNR 29 csv: 196 q:3

HYDRAULICS:
Making use of the knowledge of fluid dynamics: continuity equation; energy equation; resistance to flow; momentum equation. Application of this knowledge to pipes, tubes, nozzles, elbows, pumps, turbines, etc.

CM 010 ABST f: ESS 8 E/R 21 RSR 31 UNR 32 csv: 189 q:2

HYDRAULICS:
Making use of the knowledge of open channel flow: formulae and charts.

CM 011 ABST f: ESS 6 E/R 13 RSR 28 UNR 37 csv: 156 q:2

HYDRAULICS:
Making use of the knowledge of alternate depth of flow, specific energy; critical velocity, slope and depth; cross-section of most efficiency; hydraulic jump; Froude number; flow measurement.

CEM 012 ABST f: ESS 5 E/R 8 RSR 28 UNR 38 csv: 138 q:1 ***

HEATING, VENTILATING AND AIR CONDITIONING:
Making use of a knowledge of physics pertaining to heating, cooling and ventilation: temperature scales; conservation of energy; BTU and specific heat; sensible and latent heat, enthalpy; pressures; comfort conditions, effective temperature.

CEM 013 ABST f: ESS 6 E/R 10 RSR 24 UNR 41 csv: 143 q:1 ***

HEATING, VENTILATING AND AIR CONDITIONING:
Making use of a knowledge of heat losses: quantity of heat to be removed or supplied; flow of heat; conductivity; transmission coefficients; infiltration; actual load calculation through walls, ceilings, roofs and floors.

CEM 014 ABST f: ESS 3 E/R 8 RSR 16 UNR 52 csv: 120 q:1 ***

HEATING, VENTILATING AND AIR CONDITIONING:
Making use of a knowledge of psychrometrics: heating and cooling; humidification and dehumidification; evaporative cooling; mixing of air quantities; construction of psychrometric chart and plotting of air conditioning processes on the chart.

CEM 015 ABST f: ESS 5 E/R 12 RSR 24 UNR 42 csv: 146 q:1 ***

HEATING, VENTILATING AND AIR CONDITIONING:
Making use of a knowledge of air distribution: duct sizing; evaluation of energy losses in straight ducts, elbows, transition pieces, etc.; outlets, grilles, diffusers; equal friction and constant velocity design methods.

CEM 016 ABST f: ESS 1 E/R 10 RSR 18 UNR 52 csv: 122 q:1 ***

HEATING, VENTILATING AND AIR CONDITIONING:
Making use of a knowledge of air systems, their characteristics and methods of temperature control: central station low velocity systems; multizone systems; induction systems; dual duct systems; terminal reheat systems; package type units.

CEM 017 ABST f: ESS 2 E/R 8 RSR 22 UNR 47 csv: 145 q:1 ***

HEATING, VENTILATING AND AIR CONDITIONING:
Making use of a knowledge of steam heating installations, their application and layout: one pipe systems; two pipe systems; air vent systems; vacuum systems; sub-atmospheric systems; steam heating specialties, steam traps, air vents, etc.

CEM 018 ABST f: ESS 2 E/R 14 RSR 25 UNR 44 csv: 154 q:1 ***

HEATING, VENTILATING AND AIR CONDITIONING:
Making use of a knowledge of hot water heating: classifications of piping layout - one pipe, two pipe, monoflow system, direct return and reversed return; pump performance; sizing of hot water lines.

CE 229 ABST f: ESS 9 E/R 17 RSR 33 UNR 29 csv: 182 q:2

APPLIED PHYSICS:
Making use of the knowledge of temperature and heat: Fahrenheit and Celsius scales; absolute scales; heat as a form of energy; internal energy; heat units; specific heat; heat of combustion; calorimetry.

CE 230 ABST f: ESS 9 E/R 15 RSR 30 UNR 32 csv: 173 q:2

APPLIED PHYSICS:
Making use of the knowledge of thermal expansion: expansion of solids; differential expansion; expansion in area; volume expansion; heating a gas at constant volume; expansion of gases; general gas law.

CE 231 ABST f: ESS 7 E/R 14 RSR 21 UNR 43 csv: 155 q:2

APPLIED PHYSICS:
Making use of the knowledge of change of phase: melting point; supercooling; heat of fusion; change of volume during freezing; effect of pressure on melting point; freezing point of a solution; saturated vapor; evaporation and boiling; heat of vaporization; boiling point of a solution; sublimation; triple point.

CE 232 ABST f: ESS 6 E/R 12 RSR 22 UNR 43 csv: 147 q:1 ***

APPLIED PHYSICS:
Making use of the knowledge of heat transfer: conduction; convestion; radiation; black body radiation; Newton's law of cooling.

CE 233 ABST f: ESS 4 E/R 10 RSR 16 UNR 51 csv: 129 q:1 ***

APPLIED PHYSICS:
Making use of the knowledge of electric charges at rest: charges by contact and separation; electrical structure of matter; conductors and insulators; law of conservation of charge; Coulomb's law; electric field intensity; lines of force; electrostatic induction; electroscope.

CE 234 ABST f: ESS 3 E/R 12 RSR 16 UNR 52 csv: 132 q:1 ***

APPLIED PHYSICS:
Making use of the knowledge of potential: potential energy in an electric field; potential due to a point charge; potential difference.

CE 235 ABST f: ESS 6 E/R 16 RSR 24 UNR 41 csv: 161 q:2

APPLIED PHYSICS:
Making use of the knowledge of electric current and resistance: currents and their effects; direction of a current; Ohm's law for a resistor; Joule's law of heating; resistivity; temperature coefficient of resistance; superconductivity; qualitative considerations in conduction; resistors in series; resistors in parallel.

CE 236 ABST f: ESS 5 E/R 14 RSR 19 UNR 47 csv: 147 q:1 ***

APPLIED PHYSICS:
Making use of the knowledge of electric circuits: electromotive force; conservation of energy in a simple circuit; resistances of sources of emf; charging a battery; cells in series; Ohm's law for a complete circuit; Kirchhoff's laws; Wheatstone Bridge; potentiometer/

CE 237 ABST f: ESS 4 E/R 9 RSR 15 UNR 52 csv: 125 q:1 ***

APPLIED PHYSICS:
Making use of the knowledge of magnetic fields of currents: magnets; magnetic field; magnetic force on a moving charge; magnetic moment of a coil; moving-coil galvanometer; ammeters and voltmeters.

CE 238 ABST f: ESS 2 E/R 10 RSR 14 UNR 55 csv: 121 q:1 ***

APPLIED PHYSICS:
Making use of the knowledge of induced electromotive forces: induced emf; magnetic flux - the weber; Faraday's law of electromagnetic induction; Lenz's law; motional emf; emf in a rotating loop; mutual inductance; transformers; induction coils; self-inductance.

CE 239 ABST f: ESS 5 E/R 15 RSR 21 UNR 45 csv: 152 q:1 ***

APPLIED PHYSICS:
Making use of the knowledge of generators and motors: instantaneous emf; collecting rings; commutator; practical generators; excitation of the fields of generators; efficiency of generators; electric motors; back emf in a motor; series-wound and shut-wound motors; dynamo.

CE 240 ABST f: ESS 6 E/R 13 RSR 19 UNR 46 csv: 147 q:1 ***

APPLIED PHYSICS:
Making use of the knowledge of alternating current: alternating emf; effective value of alternating current; advantages of AC transmission; current in an inductive circuit.

CT 019 NEUT f: ESS 34 E/R 52 RSR 32 UNR 5 csv: 361 q:4

TOPOGRAPHIC DRAFTING:
Making use of the knowledge of topographic mapping: types and uses of maps, their composition; map symbols and lettering; map interpretation.

CT 020 NEUT f: ESS 40 E/R 57 RSR 28 UNR 3 csv: 390 q:4

TOPOGRAPHIC DRAFTING:
Making use of the knowledge of the systems of survey in Western Canada: astronomical concepts; the Third System of Survey (monumentation of land, townships and ranges, baselines and correction lines, fract'al townships and sections).

CT 021 APPL f: ESS 39 E/R 53 RSR 24 UNR 8 csv: 371 q:4

TOPOGRAPHIC DRAFTING:
Making use of the knowledge of relief, and doing contouring: interpreting and reducing field notes; plotting contour lines (by approximation, graphical and/or mathematical interpolation); plotting profiles.

CT 022 APPL f: ESS 33 E/R 44 RSR 26 UNR 12 csv: 328 q:4

TOPOGRAPHIC DRAFTING:
Determining areas by the use of a polar planimeter.

CT 023 APPL f: ESS 31 E/R 44 RSR 23 UNR 17 csv: 319 q:4

TOPOGRAPHIC DRAFTING:
Plotting highway curves - horizontal curves.

CT 024 APPL f: ESS 29 E/R 39 RSR 24 UNR 18 csv: 299 q:4

TOPOGRAPHIC DRAFTING:
Plotting highway curves - vertical curves.

CT 025 APPL f: ESS 38 E/R 50 RSR 23 UNR 10 csv: 358 q:4

TOPOGRAPHIC DRAFTING:
Earthwork: plotting cross sections from field notes.

CT 026 APPL f: ESS 27 E/R 42 RSR 28 UNR 16 csv: 306 q:4

TOPOGRAPHIC DRAFTING:
Doing earth volume computations; cut and fill.

CT 033 NEUT f: ESS 15 E/R 34 RSR 41 UNR 15 csv: 259 q:4

AERIAL PHOTO INTERPRETATION:
Making use of photogrammetric terminology; the geometry of aerial photographs (scale, height measurements); the camera; photo annotation; stereovision; the pocket and mirror stereoscopes.

CT 034 APPL f: ESS 1 E/R 14 RSR 32 UNR 38 csv: 148 q:1 ***

AERIAL PHOTO INTERPRETATION:
Making use of a general knowledge of flight planning.

CT 035 APPL f: ESS 0 E/R 7 RSR 22 UNR 49 csv: 114 q:1 ***

AERIAL PHOTO INTERPRETATION:
Performing the computations necessary for flight planning; preparing flight plan diagrams.

CT 036 NEUT f: ESS 8 E/R 19 RSR 35 UNR 28 csv: 187 q:2

AERIAL PHOTO INTERPRETATION:
Making use of the knowledge of drainage patterns; fluvial land forms; aeolian land forms; organic-mineral complexes; and characteristics of streams and rivers.

CT 037 APPL f: ESS 16 E/R 40 RSR 40 UNR 15 csv: 279 q:4

AERIAL PHOTO INTERPRETATION:
Using simple methods of plotting for the transfer of information from aerial photographs to drawings.

T 038 APPL f: ESS 3 E/R 12 RSR 27 UNR 41 csv: 143 q:1 ***

AERIAL PHOTO INTERPRETATION:
Using sophisticated commercial methods of plotting for the transfer of information from stereo-pairs to drawings (e.g., the Kelch plotter).

CST 039 NEUT f: ESS 16 E/R 25 RSR 33 UNR 22 csv: 227 q:3

SURVEY THEORY AND PRACTICE IN GENERAL:
Making relatively frequent references to a textbook in this area, and/or A Manual of Instructions for Alberta Land Surveyors, and/or Manual of Instructions for Dominion Land Surveyors (and its supplement).

CST 040 APPL f: ESS 30 E/R 40 RSR 25 UNR 16 csv: 306 q:4

SURVEY THEORY AND PRACTICE IN GENERAL:
Relatively frequent use of mathematical tables for the purpose of computations.

CST 041 APPL f: ESS 39 E/R 57 RSR 26 UNR 6 csv: 385 q:4

SURVEY PLANS IN GENERAL:
Map and plan reading (interpreting information conveyed by a map or plan).

CS 248 NEUT f: ESS 9 E/R 23 RSR 37 UNR 25 csv: 204 q:3

MATERIALS OF CONSTRUCTION:
Making use of the knowledge of properties, uses, advantages and limitations of: soil; foundations.

CS 249 NEUT f: ESS 7 E/R 20 RSR 38 UNR 26 csv: 190 q:3

MATERIALS OF CONSTRUCTION:
Making use of the knowledge of properties, uses, advantages and limitations of: concrete aggregate; concrete mix design, additives, finishes; concrete tests; concrete products.

CS 250 NEUT f: ESS 6 E/R 17 RSR 32 UNR 33 csv: 172 q:2

MATERIALS OF CONSTRUCTION:
Making use of the knowledge of properties, uses, advantages and limitations of: wood products; lath - plaster - stucco - drywall - steel - miscellaneous metal; masonry - brick - block - stone.

CS 251 NEUT f: ESS 6 E/R 17 RSR 31 UNR 34 csv: 171 q:2

MATERIALS OF CONSTRUCTION:
Making use of the knowledge of properties, uses, advantages and limitations of: roofing materials - insulation - plastics - glass; floor coverings - paint and wall finishes - glue - caulking.

E 101 ABST f: ESS 0 E/R 7 RSR 20 UNR 51 csv: 112 q:1 ***

BUILDING SERVICES DRAFTING:
Doing air conditioning load analyses: load classification; variability of the cooling load; design conditions; building heat transmission; heat gains from outside air; solar radiation; occupant load; electric motor and appliance loads; miscellaneous heat gains.

E 102 ABST f: ESS 0 E/R 9 RSR 21 UNR 50 csv: 119 q:1 ***

BUILDING SERVICES DRAFTING:
Making use of the knowledge of winter air conditioning loads: types of loads; building heat losses; heating load due to ventilation and infiltration; duct heat losses and air leakage.

E 103 ABST f: ESS 0 E/R 6 RSR 19 UNR 52 csv: 108 q:1 ***

BUILDING SERVICES DRAFTING:
Performing load calculations: engineering analysis of air conditioning loads; semi-engineering analysis; shortcut load analysis for summer cooling; load calculations for residential air conditioning.

E 104 ABST f: ESS 0 E/R 5 RSR 16 UNR 55 csv: 102 q:1 ***

BUILDING SERVICES DRAFTING:
Making use of the knowledge of equipment selection: cooling and dehumidifying equipments: methods of heat and moisture removal; basic equations (H_s, H_L, S.H.F.); conditioning of entering air - air mixing; bypass factor, apparatus dew point, and sensible heat factor (relationship); heating and humidification.

E 105 ABST f: ESS 1 E/R 4 RSR 15 UNR 55 csv: 98 q:1 ***

BUILDING SERVICES DRAFTING:
Making use of the knowledge of mechanical refrigeration: thermodynamics of refrigeration; refrigerants and refrigeration cycle; refrigerant properties and Mollier chart; efficiency of refrigeration machines, heat pump and performance tests. C.O.P.

E 106 ABST f: ESS 0 E/R 6 RSR 16 UNR 55 csv: 105 q:1 ***

BUILDING SERVICES DRAFTING:
Making use of the knowledge of refrigeration system equipment: reciprocating and centrifugal compressors; evaporators and chillers; water cooling equipment.

E 107 ABST f: ESS 3 E/R 10 RSR 19 UNR 49 csv: 129 q:1 ***

BUILDING SERVICES DRAFTING:
Making use of the knowledge of air distribution: standards of air flow; duct work; principles of air flow; duct systems and sizing; velocity method; static regain method; air distribution in rooms - suuply and R. A. outlets, registers and grilles; air cleaning methods.

E 151 NEUT f: ESS 14 E/R 30 RSR 35 UNR 22 csv: 238 q:3

ELECTRICAL DRAFTING:
Making use of the knowledge of electrical symbols and the characteristics of electrical drawings for architectural plans and for diagrams.

E 152 ABST f: ESS 12 E/R 29 RSR 33 UNR 26 csv: 227 q:3

ELECTRICAL DRAFTING:
Making use of the knowledge of basic electrical theory, electrical circuit design, and the generation and distribution of power.

E 153 APPL f: ESS 12 E/R 27 RSR 29 UNR 30 csv: 217 q:3

ELECTRICAL DRAFTING:
Drafting either or all of: block diagrams, point-to-point wiring diagrams, highway and baseline diagrams, schematic diagrams, single line electrical distribution diagrams.

E 154 APPL f: ESS 9 E/R 24 RSR 32 UNR 30 csv: 202 q:3

ELECTRICAL DRAFTING:
Drawing illumination and lighting systems; electrical services and distribution for residential and/or commercial buildings; electrical installations and equipment.

E 155 APPL f: ESS 4 E/R 13 RSR 28 UNR 39 csv: 150 q:1 ***

ELECTRICAL DRAFTING:
Designing complete electrical systems for residential and/or commercial buildings.

E 156 NEUT f: ESS 4 E/R 13 RSR 24 UNR 43 csv: 146 q:1 ***

ELECTRICAL DRAFTING:
Making frequent references to the Canadian Electrical Code (C.S.A.)

E 157 APPL f: ESS 11 E/R 20 RSR 21 UNR 39 csv: 185 q:2

ELECTRONIC DRAFTING:
Drawing electronic schematic diagrams.

E 158 ABST f: ESS 2 E/R 7 RSR 18 UNR 51 csv: 116 q:1 ***

ELECTRONIC DRAFTING:
Making use of the knowledge of thermionic vacuum tube circuits; circuits employing solid state devices; and miniturization and modular components.

E 159 APPL f: ESS 8 E/R 15 RSR 20 UNR 43 csv: 160 q:2

ELECTRICAL DRAFTING:
Preparing connection or wiring diagrams: printed circuits; point-to-point wiring diagrams; highway and baseline wiring diagrams; wiring harness and local cabling.

E 160 APPL f: ESS 12 E/R 21 RSR 23 UNR 36 csv: 193 q:3

ELECTRICAL DRAFTING:
Preparing residential wiring drawings: floor plans including all electrical circuits, switches, fixtures and outlets; fixture schedules and legends.

E 161 APPL f: ESS 11 E/R 16 RSR 23 UNR 37 csv: 175 q:2

ELECTRICAL DRAFTING:
Preparing commercial wiring diagrams: floor plans including all electrical circuits, switches, fixtures and outlets; fixture schedules and conduit schedules.

M 084 NEUT f: ESS 23 E/R 37 RSR 27 UNR 21 csv: 278 q:4

MACHINE DRAFTING:
Making use of the knowledge of surface quality: finish; roughness; application of symbols and ratings.

M 085 NEUT f: ESS 21 E/R 36 RSR 29 UNR 21 csv: 271 q:4

MACHINE DRAFTING:
Making use of the knowledge of material specification, the S.A.E. and A.S.T.M. systems for steel, cast iron, aluminum, carbon-base alloys.

M 086 NEUT f: ESS 29 E/R 39 RSR 26 UNR 16 csv: 301 q:4

MACHINE DRAFTING:
Making use of the knowledge of piping drawing: sizes, fittings, valves; bends; identification, symbols and dimensioning.

M 087 NEUT f: ESS 33 E/R 40 RSR 22 UNR 16 csv: 322 q:4

MACHINE DRAFTING:
Making use of the knowledge of welding drawing: types of joints, welding processes, welding symbols, brazing, soldering.

M 088 NEUT f: ESS 26 E/R 37 RSR 26 UNR 19 csv: 286 q:4

MACHINE DRAFTING:
Making use of the knowledge of fasteners: classification; nails, screws, tapping screws, rivets; screw threads and profiles; bolts, studs, set screws, cap and machine screws; nuts, washers, pins, keys and springs.

M 089 NEUT f: ESS 21 E/R 33 RSR 30 UNR 20 csv: 263 q:4

MACHINE DRAFTING:

Making use of the knowledge of precision dimensioning; limits and tolerances; methods of tolerancing; interchangeability and fits; standard cylindrical fits; dimensioning for cylindrical fits; tolerance accumulation.

M 090 NEUT f: ESS 11 E/R 27 RSR 25 UNR 35 csv: 210 q:3

MACHINE DRAFTING:

Making use of the knowledge of bearings: ball bearings, roller bearings, cylindrical bearings; their selection, load carrying capacities, speed vs. life; familiarity with bearing catalogues.

M 091 NEUT f: ESS 10 E/R 22 RSR 21 UNR 40 csv: 188 q:2

MACHINE DRAFTING:

Making use of the knowledge of gearing: spur gears, bevel gears, worm gears; their formulae and calculations, data required for working drawings (basic specifications); data basic to the design of gear.

M 092 NEUT f: ESS 10 E/R 21 RSR 25 UNR 36 csv: 189 q:2

MACHINE DRAFTING:

Making use of the knowledge of mechanical drives: V-belt drives, roller chain drives, worm gear reducers, couplings and clutches; making frequent references to manufacturer's catalogues.

M 093 APPL f: ESS 11 E/R 25 RSR 27 UNR 33 csv: 206 q:3

MACHINE DRAFTING:

Drafting involving bearings, gears, mechanical drives, and miscellaneous machine elements.

M 094 NEUT f: ESS 15 E/R 23 RSR 24 UNR 32 csv: 209 q:3

MACHINE DRAFTING:

Making use of a thorough knowledge of the graphic representation of pressure vessels, storage tanks, etc.

M 095 NEUT f: ESS 10 E/R 21 RSR 25 UNR 36 csv: 189 q:2

MACHINE DRAFTING:

Making use of a thorough knowledge of design principles, methods of fabrication, and materials used in the fabrication of pressure vessels, storage tanks, etc.

M 096 APPL f: ESS 9 E/R 21 RSR 20 UNR 42 csv: 181 q:2

MACHINE DRAFTING:

Preparing design and fabrication drawings of shells for large storage tanks.

M 097 APPL f: ESS 9 E/R 19 RSR 16 UNR 46 csv: 171 q:2

MACHINE DRAFTING:

Preparing design and fabrication drawings of shells for flat-bottomed cylindrical vessels.

M 098 APPL f: ESS 9 E/R 17 RSR 18 UNR 44 csv: 167 q:2

MACHINE DRAFTING:
Preparing design and fabrication drawings for tall vertical vessels.

M 099 NEUT f: ESS 10 E/R 16 RSR 16 UNR 45 csv: 165 q:2

MACHINE DRAFTING:
Making frequent references to the ASME Boiler and Pressure Vessel Code.

M 100 NEUT f: ESS 1 E/R 9 RSR 16 UNR 54 csv: 117 q:1 ***

MACHINE DRAFTING:
Making frequent use of Fogle's Tables.

M 241 NEUT f: ESS 3 E/R 10 RSR 24 UNR 44 csv: 134 q:1 ***

WELDING:
Making use of a knowledge of shop practice in the care and safe handling of arc welding equipment.

M 242 NEUT f: ESS 2 E/R 11 RSR 25 UNR 44 csv: 135 q:1 ***

WELDING:
Making use of a knowledge of shop practice in the care and safe handling of oxy-acetylene welding equipment.

M 243 NEUT f: ESS 3 E/R 14 RSR 28 UNR 40 csv: 150 q:1 ***

WELDING:
Making use of a knowledge of types of flames and their uses; gas welding rods and fluxes; fusion welding mild steel and cast iron.

M 244 NEUT f: ESS 3 E/R 16 RSR 30 UNR 38 csv: 158 q:2

WELDING:
Making use of a knowledge of oxy-acetylene welding; hand and machine cutting.

M 245 NEUT f: ESS 2 E/R 11 RSR 26 UNR 43 csv: 136 q:1 ***

WELDING:
Making use of a knowledge of types of arc welding machines and their setting; machine care and maintenance; mild steel electrodes.

M 246 NEUT f: ESS 7 E/R 20 RSR 34 UNR 30 csv: 186 q:2

WELDING:
Making use of a knowledge of joint preparation; beading; butt welding of gauge plate.

M 247 APPL f: ESS 1 E/R 5 RSR 14 UNR 56 csv: 103 q:1 ***

WELDING:
Occasionally performing welding operations.

M 269 NEUT f: ESS 8 E/R 19 RSR 29 UNR 34 csv: 181 q:2

INDUSTRIAL PRACTICES:
In the course of one's work profiting from a knowledge of machine shop practices: the use of cutting and non-cutting handtools, and layout instruments.

M 270 NEUT f: ESS 10 E/R 20 RSR 24 UNR 37 csv: 155 q:2

INDUSTRIAL PRACTICES:
In the course of one's work profiting from a knowledge of machine operations: drilling machines, reamers, taps and dies, engine lathes.

M 271 NEUT f: ESS 10 E/R 18 RSR 21 UNR 40 csv: 176 q:2

INDUSTRIAL PRACTICES:
In the course of one's work profiting from first-hand (machine shop) knowledge of measurement and gauging: limits and fits, interchangeability; precision measuring instruments; limit gauging; surface finish measuring.

M 272 NEUT f: ESS 2 E/R 9 RSR 31 UNR 38 csv: 135 q:1 ***

INDUSTRIAL PRACTICES IN THE PIPE TRADES:
Making use of a knowledge of the responsibilities of the Plumber, the Gasfitter, the Steamfitter.

M 273 NEUT f: ESS 9 E/R 18 RSR 23 UNR 39 csv: 175 q:2

INDUSTRIAL PRACTICES IN THE PIPE TRADES:
Making use of a knowledge of ferrous metals, non-ferrous metals, and non-metallic materials.

M 274 NEUT f: ESS 14 E/R 27 RSR 28 UNR 29 csv: 222 q:3

INDUSTRIAL PRACTICES IN THE PIPE TRADES:
Making use of a knowledge of pipes, fittings, supports, and joining techniques: steel, cast iron, copper, plastic, brass, bronze, aluminum, lead, vitrified clay, bituminous fibre, glass, sheet metal, stainl. steel.

M 275 NEUT f: ESS 13 E/R 29 RSR 29 UNR 29 csv: 226 q:3

INDUSTRIAL PRACTICES IN THE PIPE TRADES:
Making use of a knowledge of properties, selection and application of valves.

M 276 NEUT f: ESS 5 E/R 16 RSR 30 UNR 36 csv: 164 q:2

INDUSTRIAL PRACTICES IN THE PIPE TRADES:
Making use of a knowledge of equipment: plumbing fixtures, accessories, hydraulic loads; gas appliances, accessories, BTU rating; boilers, accessories, BTU rating, EDR HP rating.

M 277 NEUT f: ESS 5 E/R 23 RSR 32 UNR 34 csv: 187 q:2

INDUSTRIAL PRACTICES IN THE PIPE TRADES:
Making use of a knowledge of approved methods of installation: waterlines; drain and vent lines; gas lines; hot water heating; steam lines; equipment; sanitation and safety aspects.

M 278 NEUT f: ESS 4 E/R 10 RSR 21 UNR 46 csv: 134 q:1 ***

INDUSTRIAL PRACTICES IN THE PIPE TRADES:
Making frequent or occasional reference to the Plumbing, Gasfitting and Boiler installation codes.

MST 253 NEUT f: ESS 33 E/R 56 RSR 32 UNR 6 csv: 370 q:4

STATICS:
Making use of trigonometric functions, the sine law and cosine law; solving right and oblique triangles.

MS 252 NEUT f: ESS 8 E/R 15 RSR 23 UNR 40 csv: 163 q:2

STATICS:
Making frequent use of a knowledge of the methods of analyzing and solving force systems acting on rigid bodies at rest.

MS 254 NEUT f: ESS 9 E/R 20 RSR 25 UNR 37 csv: 183 q:2

STATICS:
Making use of the knowledge of Newton's laws, force, rigid body, vectors and scalars, transmissibility of forces, types of force systems.

MS 255 NEUT f: ESS 7 E/R 20 RSR 32 UNR 32 csv: 184 q:2

STATICS:
Making use of the knowledge of resultants and components: parallelogram, triangle and polygon of forces, orthogonal components, resultants of concurrent and non-concurrent force; graphical solutions.

MS 256 ABST f: ESS 5 E/R 21 RSR 27 UNR 39 csv: 176 q:2

STATICS:
Making use of the knowledge of moments and couples: moment, sign convention, Varignon's theorem, couples.

MS 257 ABST f: ESS 8 E/R 17 RSR 33 UNR 30 csv: 179 q:2

STATICS:
Making use of the knowledge of equilibrium: types of reactions (rollers, hinges, pins, etc.), free body diagrams, reactions on beams with point loads and uniformly distributed loads.

MS 258 ABST f: ESS 10 E/R 17 RSR 22 UNR 39 csv: 174 q:2

STATICS:
Making use of the knowledge of centre of gravity, and centroids.

MS 259 ABST f: ESS 8 E/R 17 RSR 21 UNR 42 csv: 167 q:2

STATICS:
Making use of the knowledge of moments of inertia: of simple and composite rectangular areas, section modules with reference to the steel or timber handbooks.

MS 260 NEUT f: ESS 15 E/R 24 RSR 24 UNR 32 csv: 212 q:3

STATICS:
Making frequent references to the C.I.S.C. Steel Handbook.

S 108 NEUT f: ESS 6 E/R 23 RSR 40 UNR 25 csv: 198 q:3

BUILDING SERVICES DRAFTING:
Making use of the knowledge of plumbing and drainage regulations: administrative authority; permits; general requirements (changes in direction, connection to sewerage system, hangers and supports); required plumbing facilities.

S 109 NEUT f: ESS 11 E/R 23 RSR 35 UNR 25 csv: 208 q:3

BUILDING SERVICES DRAFTING:
Making use of the knowledge of plumbing and drainage materials: pipes and flanges; plumbing fixtures; soil and waste pipes; traps, interceptors and cleanouts; venting systems; water supply and distribution.

S 110 APPL f: ESS 24 E/R 38 RSR 25 UNR 22 csv: 282 q:4

STRUCTURAL DRAFTING:
Performing structural design drawings.

S 111 APPL f: ESS 16 E/R 33 RSR 27 UNR 28 csv: 245 q:3

STRUCTURAL DRAFTING:
Performing structural shop drawings.

S 112 APPL f: ESS 23 E/R 37 RSR 28 UNR 20 csv: 279 q:4

STRUCTURAL DRAFTING:
Using structural drafting techniques; layout and arrangement of views; structural dimensioning.

S 113 NEUT f: ESS 10 E/R 31 RSR 35 UNR 26 csv: 229 q:3

STRUCTURAL DRAFTING:
Making use of the knowledge of physical properties and manufacturing techniques of structural steel; material handling and cutting.

S 114 ABST f: ESS 13 E/R 33 RSR 30 UNR 28 csv: 239 q:3

STRUCTURAL DRAFTING:
Making use of the knowledge of strength of materials applied to bolts and weld: shear; bearing; moments; shear force and bending moment diagrams.

S 115 NEUT f: ESS 13 E/R 32 RSR 32 UNR 26 csv: 238 q:3

STRUCTURAL DRAFTING:
Making use of the knowledge of connections: shop bolted - field bolted; shop welded - field welded; shop welded - field bolted.

S 116 APPL f: ESS 10 E/R 22 RSR 32 UNR 29 csv: 199 q:3

STRUCTURAL DRAFTING:
Doing shop drawings involving square framed beams: framed connections; seated connections; beam details.

S 117 APPL f: ESS 7 E/R 16 RSR 33 UNR 31 csv: 173 q:2

STRUCTURAL DRAFTING:
Doing shop drawings involving special framed beam connections: connections connections for large beam reaction; connections for small beam reaction; modification of standard connections to suit special conditions.

S 118 APPL f: ESS 13 E/R 24 RSR 27 UNR 31 csv: 209 q:3

STRUCTURAL DRAFTING:
Doing shop drawings involving column details: column schedules; column base plate details; column splice details; column marking; opposite hand columns; bill of materials.

S 119 NEUT f: ESS 17 E/R 33 RSR 28 UNR 26 csv: 249 q:3

STRUCTURAL DRAFTING:
Making relatively frequent references to the Manual of Steel Construction and/or the Handbook of Structural Detail for Buildings.

S 120 NEUT f: ESS 16 E/R 34 RSR 28 UNR 27 csv: 249 q:3

STRUCTURAL DRAFTING:
Making use of a thorough knowledge of foundations, structural concrete floor framing, and concrete block buildings.

S 121 NEUT f: ESS 16 E/R 26 RSR 30 UNR 25 csv: 227 q:3

STRUCTURAL DRAFTING:
Making use of a thorough knowledge of columns, beams, joists, decking, base plates, and splice plates.

S 122 NEUT f: ESS 11 E/R 17 RSR 22 UNR 38 csv: 177 q:2

STRUCTURAL DRAFTING:
Making use of a knowledge of Glu-lam beams and Glu-lam columns; masonry seats, column seats, base plates.

S 123 NEUT f: ESS 11 E/R 17 RSR 27 UNR 33 csv: 182 q:2

STRUCTURAL DRAFTING:
Making use of a knowledge of wood joists (bearing on masonry, bearing on wood ledges, decking materials on wood joists); Glu-lam stairs.

S 124 ABST f: ESS 6 E/R 16 RSR 31 UNR 34 csv: 168 q:2

STRUCTURAL DRAFTING:
Making use of a thorough knowledge of the structural behaviour of steel elements, the reasons behind the method of detailing, and code limits.

S 125 APPL f: ESS 8 E/R 23 RSR 29 UNR 34 csv: 193 q:3

STRUCTURAL DRAFTING:
Preparing quantity estimates of buildings.

S 126 NEUT f: ESS 6 E/R 29 RSR 29 UNR 36 csv: 205 q:3

STRUCTURAL DRAFTING:
Making relatively frequent use of the Manual of Standard Practice for Detailing Reinforced Concrete Structures (A.C.I.).

S 127 APPL f: ESS 7 E/R 21 RSR 27 UNR 37 csv: 182 q:2

STRUCTURAL DRAFTING:
Preparing concrete and rebar estimates of buildings.

S 128 APPL f: ESS 12 E/R 21 RSR 25 UNR 34 csv: 195 q:3

STRUCTURAL DRAFTING:
Preparing placing drawings and bar lists of buildings.

S 129 APPL f: ESS 11 E/R 21 RSR 24 UNR 36 csv: 191 q:3

STRUCTURAL DRAFTING:
Preparing stair details of buildings.

S 130 APPL f: ESS 13 E/R 25 RSR 32 UNR 26 csv: 217 q:3

STRUCTURAL DRAFTING:
Preparing foundation plans of buildings.

S 131 APPL f: ESS 16 E/R 30 RSR 31 UNR 24 csv: 240 q:3

STRUCTURAL DRAFTING:
Preparing floor plans of buildings.

S 132 APPL f: ESS 16 E/R 28 RSR 31 UNR 24 csv: 234 q:3

STRUCTURAL DRAFTING:
Preparing wall sections of buildings.

S 133 APPL f: ESS 7 E/R 18 RSR 26 UNR 38 csv: 172 q:2

STRUCTURAL DRAFTING:
Preparing precast details for buildings.

S 134 NEUT f: ESS 13 E/R 22 RSR 25 UNR 33 csv: 201 q:3

STRUCTURAL DRAFTING:
Working out beam elevations.

S 135 NEUT f: ESS 9 E/R 17 RSR 24 UNR 38 csv: 173 q:2

STRUCTURAL DRAFTING:
Preparing beam, joist, column, lintel schedules.

S 136 NEUT f: ESS 15 E/R 29 RSR 33 UNR 23 csv: 236 q:3

ARCHITECTURAL DRAFTING:
Making use of the knowledge of (residential) house planning principles and basic house structures.

S 137 NEUT f: ESS 17 E/R 30 RSR 29 UNR 25 csv: 241 q:3

ARCHITECTURAL DRAFTING:
Making use of a thorough knowledge of footings and foundations; frame construction; roof construction; exterior and interior finishes; insulation and vapor barrier.

S 138 APPL f: ESS 20 E/R 30 RSR 24 UNR 27 csv: 245 q:3

ARCHITECTURAL DRAFTING:
Preparing architectural working drawings: main floor plans; basement plans; wall sections; building cross sections; elevations; stair details; door jamb details; room finish schedules and door schedules; site plans.

S 139 NEUT f: ESS 10 E/R 21 RSR 26 UNR 35 csv: 190 q:3

ARCHITECTURAL DRAFTING:
Making frequent references to the C.M.H.C. publication "Canadian Woodframe House Construction".

S 140 NEUT f: ESS 16 E/R 26 RSR 23 UNR 32 csv: 220 q:3

ARCHITECTURAL DRAFTING:
Making frequent references to the National Building Code of Canada, and its supplement.

S 145 APPL f: ESS 10 E/R 18 RSR 24 UNR 37 csv: 179 q:2

ARCHITECTURAL DRAFTING:
Preparing working drawings for commercial or institutional buildings in either or all of: Glu-lam beam; woodframing; concrete; concrete block; and brick veneer construction.

S 146 NEUT f: ESS 8 E/R 16 RSR 22 UNR 41 csv: 165 q:2

ARCHITECTURAL DRAFTING:
For the purpose of checking and/or estimating, but not drafting, making use of a thorough knowledge of either or all of: Glu-lam beam; woodframing; concrete; concrete block; and brick veneer construction.

S 147 APPL f: ESS 19 E/R 31 RSR 33 UNR 19 csv: 254 q:4

ARCHITECTURAL DRAFTING:
Making use of the knowledge and skills required for the preparation of architectural working drawings: layout; linework; method of dimensioning; architectural lettering; architectural symbols; check points.

S 148 APPL f: ESS 11 E/R 24 RSR 29 UNR 31 csv: 205 q:3

ARCHITECTURAL DRAFTING:
Performing architectural working drawings under supervision: all basic dimensions and specifications given.

S 149 APPL f: ESS 9 E/R 19 RSR 25 UNR 37 csv: 180 q:2

ARCHITECTURAL DRAFTING:
Performing architectural design work with no or a minimum of professional supervision.

S 150 NEUT f: ESS 4 E/R 11 RSR 24 UNR 43 csv: 140 q:1 ***

ARCHITECTURAL DRAFTING:
Making frequent references to the Canadian Government Specification Board publication "Standard on Architectural Drawing Practices".

S 141 ABST f: ESS 7 E/R 22 RSR 27 UNR 37 csv: 185 q:2

CONSTRUCTION CONTRACTS:
Having a knowledge of the need for formal contracts; and the history of law and the Canadian judicial system,

S 142 ABST f: ESS 7 E/R 23 RSR 33 UNR 31 csv: 194 q:3

CONSTRUCTION CONTRACTS:
Making use of the knowledge of written and oral contracts; being involved with either or all of the following types of contracts: lump sum, cost plus percentage, cost plus fixed fee, unit cost.

S 143 APPL f: ESS 5 E/R 16 RSR 32 UNR 34 csv: 166 q:2

CONSTRUCTION CONTRACTS:
Preparing either or all of: advertisements, instructions to bidders, bid proposals, agreements, specifications.

S 144 APPL f: ESS 5 E/R 16 RSR 30 UNR 36 csv: 164 q:2

CONSTRUCTION CONTRACTS:
Writing specifications in accordance with the Specification Writers Association format.

S 261 ABST f: ESS 12 E/R 20 RSR 26 UNR 33 csv: 193 q:3

PROPERTIES OF MATERIALS:
Making use of the knowledge of stress and strain; Hooke's law; the elongation of axially loaded members applied to experimental stress analysis; safety factors; and temperature stresses.

S 262 ABST f: ESS 10 E/R 21 RSR 24 UNR 37 csv: 188 q:2

PROPERTIES OF MATERIALS:
Making use of the knowledge of Poisson's ratio; statically indeterminate members; bolted and welded connections; shear force and bending moment in beams; stresses in beams; and the principles of beam design.

S 263 ABST f: ESS 6 E/R 20 RSR 28 UNR 37 csv: 177 q:2
PROPERTIES OF MATERIALS:
Making use of the knowledge of tensile, hardness, impact and fatigue tests; radiography; magnetic particle inspection; dye penetrant inspection; and ultrasonic inspection.

ST 264 APPL f: ESS 19 E/R 38 RSR 34 UNR 18 csv: 276 q:4

SURVEYING:
By doing occasional field work, drawing on the knowledge of leveling: either or all of: establishing bench marks; profile leveling; cross section leveling; grid leveling for contouring.

ST 265 APPL f: ESS 14 E/R 36 RSR 34 UNR 23 csv: 255 q:4

SURVEYING:
By doing occasional field work, drawing on the knowledge of operating an engineer's transit: setting up the transit; reading horizontal and vertical angles; sighting; obtaining distances by stadia.

ST 266 APPL f: ESS 20 E/R 42 RSR 40 UNR 11 csv: 297 q:4
SURVEYING:
By doing occasional field work, using steel tapes or chains.

ST 267 APPL f: ESS 14 E/R 38 RSR 37 UNR 20 csv: 264 q:4
SURVEYING:
By doing occasional field work, recording in field books the results of transit and tape traverses, and/or keeping leveling notes.

ST 268 APPL f: ESS 23 E/R 43 RSR 31 UNR 17 csv: 300 q:4
SURVEYING:
Reducing level notes.

T 027 ABST f: ESS 0 E/R 5 RSR 26 UNR 45 csv: 112 q:1 ***
GEOLOGICAL DRAFTING:
Making use of a general knowledge of historical geology: earth time; eras, periods and epochs; the major changes and developments in earth history.

T 028 ABST f: ESS 0 E/R 1 RSR 11 UNR 60 csv: 85 q:1 ***
GEOLOGICAL DRAFTING:
Making use of the knowledge of methods for determining geological age.

T 029 NEUT f: ESS 0 E/R 2 RSR 22 UNR 49 csv: 99 q:1 ***
GEOLOGICAL DRAFTING:
Making use of a general knowledge of physical geology: the earth's interior; the rock cycle; structural changes in the crust (mountain building and decay, folding and faulting, volcanic action, earthquakes); erosion.

T 030 NEUT f: ESS 0 E/R 5 RSR 21 UNR 50 csv: 102 q:1 ***
GEOLOGICAL DRAFTING:
Making use of the knowledge of geophysical exploration: seismic testing; shockwaves; seismometers - seismographs - seismograms; drilling for oil and gas.

T 031 APPL f: ESS 3 E/R 11 RSR 32 UNR 36 csv: 145 q:1 ***
GEOLOGICAL DRAFTING:
Interpreting geological maps and structure sections.

T 032 APPL f: ESS 5 E/R 11 RSR 25 UNR 41 csv: 144 q:1 ***
GEOLOGICAL DRAFTING:
Performing either or all of the following: drawing of Lithology logs; drawing of structural cross-sections; drawing of regional structure contour maps; plotting strike and dip, and outcrop lines, by methods of descriptive geometry.

T 042 APPL f: ESS 23 E/R 46 RSR 37 UNR 11 csv: 315 q:4
SURVEY COMPUTATIONS:
Preparation of traverse sheets: adjusting angles, determining bearings, using natural functions, balancing the survey, working out co-ordinates.

T 043 APPL f: ESS 6 E/R 25 RSR 35 UNR 30 csv: 195 q:3
SURVEY COMPUTATIONS:
Computing areas by means of double meridian distances.

T 044 APPL f: ESS 19 E/R 42 RSR 38 UNR 14 csv: 292 q:4
SURVEY COMPUTATIONS:
Computing areas by means of triangles and rectangles.

T 045 APPL f: ESS 16 E/R 37 RSR 35 UNR 20 csv: 265 q:4
SURVEY COMPUTATIONS:
Computing areas within rights-of-way by means of centreline distances.

T 046 APPL f: ESS 19 E/R 33 RSR 32 UNR 20 csv: 259 q:4
SURVEY COMPUTATIONS:
Calculating missing bearings and distances by the use of latitudes and departures, or by co-ordinates.

T 047 APPL f: ESS 4 E/R 15 RSR 33 UNR 34 csv: 191 q:3
SURVEY COMPUTATIONS:
Performing calculations by means of logarithms.

T 048 APPL f: ESS 15 E/R 31 RSR 27 UNR 29 csv: 239 q:3
SURVEY COMPUTATIONS:
Being thoroughly familiar with the operation of a manual calculating machine.

T 049 APPL f: ESS 32 E/R 55 RSR 36 UNR 3 csv: 368 q:4
SURVEY COMPUTATIONS:
Operating an electronic calculating machine.

T 050 NEUT f: ESS 11 E/R 26 RSR 31 UNR 29 csv: 213 q:3
LEGAL SURVEY REGULATIONS:
Doing work governed by the Alberta Surveys Act. (A general knowledge of pertinent sections of the act, and knowing where to look for rulings and information.)

T 051 NEUT f: ESS 10 E/R 23 RSR 34 UNR 27 csv: 204 q:3
LEGAL SURVEY REGULATIONS:
Doing work governed by The (Alberta) Land Titles Act. (A general knowledge of pertinent sections of the act, and knowing where to look for rulings and information.)

T 052 NEUT f: ESS 9 E/R 21 RSR 33 UNR 29 csv: 194 q:3
LEGAL SURVEY REGULATIONS:
Doing work governed by The Subdivision and Transfer Regulations. (A general knowledge of pertinent sections of the regulations, and knowing where to look for details.)

T 053 NEUT f: ESS 4 E/R 12 RSR 29 UNR 38 csv: 148 q:1 ***

LEGAL SURVEY REGULATIONS:
Doing work governed by the Wellsite Survey Regulations. (A general knowledge of pertinent sections of the regulations, and knowing where to look for details.)

T 054 APPL f: ESS 25 E/R 38 RSR 25 UNR 21 csv: 285 q:4

PREPARATION OF LEGAL SURVEY PLANS:
Drafting survey plans for registration: plotting from field notes and traverse sheets, inking the plot, lettering, and checking.

T 055 APPL f: ESS 28 E/R 36 RSR 22 UNR 21 csv: 285 q:4

PREPARATION OF LEGAL SURVEY PLANS:
Drafting of right-of-way plans and profiles.

T 056 APPL f: ESS 22 E/R 41 RSR 35 UNR 14 csv: 295 q:4

PREPARATION OF SURVEY PLANS (OTHER THAN LEGAL):
Drafting of certificate survey plans, building site plans; plans, profiles and cross-sections for industrial purposes.

T 057 APPL f: ESS 9 E/R 20 RSR 28 UNR 34 csv: 186 q:2

PREPARATION OF SURVEY PLANS (OTHER THAN LEGAL):
Drafting of well site and location plans, including well location traverse plans, and oilfield compiled plans.

T 058 APPL f: ESS 3 E/R 9 RSR 21 UNR 47 csv: 128 q:1 ***

CARTOGRAPHY:
Being engaged in grid construction and manuscript preparation and/or control plots and preparation of fairdrawings from manuscripts.

T 059 APPL f: ESS 5 E/R 11 RSR 21 UNR 45 csv: 140 q:1 ***

CARTOGRAPHY:
Using scribing instruments, materials and techniques; positive and negative scribing; producing of standard and colour maps by negative scribing.

T 060 APPL f: ESS 3 E/R 10 RSR 21 UNR 47 csv: 131 q:1 ***

CARTOGRAPHY:
Applying photographic and photomechanical practices; using colour separation techniques in map production.

T 061 NEUT f: ESS 2 E/R 10 RSR 22 UNR 47 csv: 129 q:1 ***

CARTOGRAPHY:
Compiling, editing and/or checking map designs. Applying the knowledge of the Universal Transverse Mercator grid system or other map projections.

T 062 APPL f: ESS 1 E/R 8 RSR 17 UNR 53 csv: 115 q:1 ***

CARTOGRAPHY:
Operating a co-ordinatograph in the production of maps.

T 063 APPL f: ESS 4 E/R 17 RSR 34 UNR 33 csv: 168 q:2

CARTOGRAPHY:
Applying cartographic drawing practices in the production of maps in one or more of the following areas: town planning; land use; geographic; hydrographic; aeronautical; photo; geological; forestry; topographic; land registration; property description.

T 064 APPL f: ESS 3 E/R 9 RSR 15 UNR 53 csv: 122 q:1 ***

CARTOGRAPHY:
Using automated cartography; number systems for computers; software and hardware computer equipment and systems; coding and handling of data; programming, digitizing and plotter operations.

T 065 NEUT f: ESS 1 E/R 4 RSR 16 UNR 54 csv: 102 q:1 ***

CARTOGRAPHY:
Performing photogrammetric flight planning and photo indexing; scale determination; selection and identification of control. Determining effects of terrain elevation and tilt of the camera.

T 066 APPL f: ESS 2 E/R 6 RSR 15 UNR 54 csv: 110 q:1 ***

CARTOGRAPHY:
Using radial line and slotted template methods of extending control; making map revisions using grid methods and the vertical sketch-master.

T 067 APPL f: ESS 8 E/R 19 RSR 26 UNR 37 csv: 178 q:2

CARTOGRAPHY:
Using simple stereographic instruments, preparing mosaics and photomaps.

T 068 APPL f: ESS 1 E/R 8 RSR 19 UNR 51 csv: 117 q:1 ***

CARTOGRAPHY:
Doing stereoplotting; form-lining with the Multiplex; using dots, grids and terrain diapositives; using methods of extending control by photo-triangulation and stereotemplates.

T 069 APPL f: ESS 2 E/R 9 RSR 15 UNR 54 csv: 119 q:1 ***

CARTOGRAPHY:
Using either or all of (or instruments similar to): the Kelsh plotter; the Wild B 9. Performing elevation readings, contouring and detail plotting.

T 070 ABST f: ESS 1 E/R 2 RSR 19 UNR 51 csv: 99 q:1 ***

CARTOGRAPHY:
Making use of the knowledge of geomorphology: structure of the earth; formation of rocks, weathering and mass wasting; underground and running water; glaciation; diastrophism; vulcanism; mountains, planes and plateaus; earthquakes; lakes; atmosphere and weather.

APPENDIX E: SAMPLE QUESTIONNAIRE

NORTHERN ALBERTA
INSTITUTE OF TECHNOLOGY
Department of
Advanced Education

QUESTIONNAIRE

No. ________

LAST NAME: ____________________ FIRST NAME: ________________
(Please print)

1 YEAR OF GRADUATION FROM N.A.I.T.:

1.1	1965	☐	1.4	1968	☐	1.7	1971	☐	1.10	1974	☐
1.2	1966	☐	1.5	1969	☐	1.8	1972	☐	1.11	1975	☐
1.3	1967	☐	1.6	1970	☐	1.9	1973	☐	1.12	did not graduate	☐

1.13 Graduated from another institution ☐
(Please specify): ____________________________ Year: ________

2 If, following graduation, you received additional formal education (e.g., University) or less formal specialized training (e.g., company training programs), please check box and specify. ☐

____

____

3 NAME OF PRESENT EMPLOYER (firm or agency):

____

4 TYPE OF ORGANIZATION YOUR EMPLOYERS REPRESENT:

4.01 Architectural ☐
4.02 Civic department ☐
4.03 Construction ☐
4.04 Consulting engineering ☐
4.05 Educational institution ☐
4.06 Electrical engineering ☐
4.07 Geological / Geophysical ☐
4.08 Government agency ☐
4.09 Land surveying ☐
4.10 Manufacturing ☐
4.11 Mapping ☐
4.12 Mechanical/Machine/Piping ☐
4.13 Mining ☐
4.14 Municipal engineering ☐
4.15 Petroleum eng. & industry ☐
4.16 Railway Company ☐
4.17 Resource developers ☐
4.18 Structural engineering ☐
4.19 Town planning ☐
4.20 Utility company ☐
4.21 Other ☐
(Please specify): ____________________________________

5 FIELD OF YOUR OWN SPECIALIZATION:

5.01 Architectural ☐
5.02 Civil ☐
5.03 Electrical/Electronic ☐
5.04 Mechanical ☐
5.05 Structural ☐
5.06 Topographical ☐
5.07 Other ☐
(Please specify): ____________________________________

6 YEARS OF WORKING EXPERIENCE:

	Since graduation:	With present employer:
10 or more	☐	☐
7 to 9	☐	☐
4 to 6	☐	☐
1 to 3	☐	☐

No. _ _ _ _ _

APPENDIX F: SAMPLE INTERVIEW SCHEDULE

7 ASET MEMBERSHIP: 7.1 YES ☐
(Alberta Society of Engineering Technologists) 7.2 NO ☐
If "YES", certified as:
Senior Technologist 7.3 ☐
Technologist 7.4 ☐
Senior Technician 7.5 ☐
Technician 7.6 ☐
If "YES", what benefits derived from membership?

_ _

_ _

8 MEMBERSHIP IN ANOTHER PROFESSIONAL ASSOCIATION: 8.1 YES ☐
If "YES", which? 8.2 NO ☐

_ _

If "YES", what benefits derived from membership?

_ _

_ _

9 PROMOTIONAL OPPORTUNITIES:
Does graduation from NAIT aid in the area of promotion? 9.1 YES ☐
9.2 NO ☐
Was there anything lacking in the NAIT program which would have been of benefit in regard to advancement? 9.3 YES ☐
9.4 NO ☐
If "YES", what?

_ _

_ _

10 HOLDING SUPERVISORY POSITION: 10.1 YES ☐
If "YES", 10.2 NO ☐
how many persons do you supervise? _ _ _ _ _ _ _ _ _ _ _
in what capacity? (Job title) _ _ _ _ _ _ _ _ _ _ _ _ _ _
reporting to whom?(Job title) _ _ _ _ _ _ _ _ _ _ _ _ _ _

11 TYPE OF WORK:
Engaged in DRAFTING: (Percent of time) 11.1 ☐ %
Engaged in OTHER DUTIES: (Percent of time) 11.2 ☐ %
Chiefly what other duties?

_ _

_ _

Over

X Do you have any other comments on the amount and quality of academic preparation needed for a successful career as an Engineering Design and Drafting Technologist?

Y What would you suggest should be included in our curriculum which has not been offered when you took the program?

Z Any other comments?

APPENDIX G

EXPERT'S COMMENT FORM AND EVALUATION OF 1st VERSION OF CARD SORT

TO BE USED WITH STUDY *"CURRICULUM PERCEPTIONS OF DRAFTING TECHNOLOGY"*

CARD No.	O.K., LEAVE AS IS	SEE COMMENTS				EXPERT'S COMMENTS AND EXPLANATIONS
		COMBINE INTO ONE	DIVIDE INTO TWO OR MORE	CHANGE AS STATED	OMIT FOR REASONS GIVEN	Evaluated by: ____________ YOUR NAME PLEASE

APPENDIX H: CLASSIFICATION OF CARD CONTENT FOR HYPOTHESES 1 - 6

ABSTRACTION ITEMS:

005 006 007 008 009 010 011 012 013 014 015 016
017 018 027 028 070 101 102 103 104 105 106 107
114 124 141 142 152 158 166 182 186 187 190 191
192 193 194 195 196 197 198 222 227 229 230 231
232 233 234 235 236 237 238 239 240 256 257 258
259 261 262 263

NEUTRAL ITEMS:

001 002 003 004 019 020 029 030 033 036 039 050
051 052 053 061 064 065 083 084 085 086 087 088
089 090 091 092 094 095 099 100 108 109 113 115
119 120 121 122 123 126 134 135 136 137 139 140
146 150 151 156 188 203 204 205 206 207 208 209
210 211 212 213 214 219 220 223 224 225 226 228
241 242 243 244 245 246 248 249 250 251 252 253
254 255 260 269 270 271 272 273 274 275 276 277
278

APPLICATION ITEMS:

021 022 023 024 025 026 031 032 034 035 037 038
040 041 042 043 044 045 046 047 048 049 054 055
056 057 058 059 060 062 063 066 067 068 069 071
072 073 074 075 076 077 078 079 080 081 082 093
096 097 098 110 111 112 116 117 118 125 127 128
129 130 131 132 133 138 143 144 145 147 148 149
153 154 155 157 159 160 161 162 163 164 165 167
168 169 170 171 172 173 174 175 176 177 178 179
180 181 183 184 195 189 199 200 201 202 215 216
217 218 221 247 264 265 266 267 268

APPENDIX J: CLASSIFICATION OF CARD CONTENT FOR HYPOTHESES 7 - 11

7 - OF MORE IMPORTANCE FOR CIVIL/MUNICIPAL:

006 007 008 009 010 011 012 013 014 015 016 017
018 019 020 021 022 023 024 025 026 033 034 035
036 037 039 040 041 186 187 188 189 190 191 192
193 194 195 196 197 198 199 200 201 202 229 230
231 232 233 234 235 236 237 238 239 240 248 249
250 251

8 - OF MORE IMPORTANCE FOR ELECTRICAL/ELECTRONIC:

012 013 014 015 016 017 018 101 102 103 104 105
106 107 151 152 153 154 155 156 157 158 159 160
161 229 230 231 232 233 234 235 236 237 238 239
240

9 - OF MORE IMPORTANCE FOR MECHANICAL:

006 007 008 009 010 011 012 013 014 015 016 017
018 084 085 086 087 088 089 090 091 092 093 094
095 096 097 098 099 100 241 242 243 244 245 246
247 252 253 254 255 256 257 258 259 260 269 270
271 272 273 274 275 276 277 278

10 - OF MORE IMPORTANCE FOR STRUCTURAL:

039 040 041 108 109 110 111 112 113 114 115 116
117 118 119 120 121 122 123 124 125 126 127 128
129 130 131 132 133 134 135 136 137 138 139 140
141 142 143 144 145 146 147 148 149 150 248 249
250 251 252 253 254 255 256 257 258 259 260 261
262 263 264 265 266 267 268

11 - OF MORE IMPORTANCE FOR TOPOGRAPHIC:

019 020 021 022 023 024 025 026 027 028 029 030
031 032 033 034 035 036 037 038 039 040 041 042
043 044 045 046 047 048 049 050 051 052 053 054
055 056 057 058 059 060 061 062 063 064 065 066
067 068 069 070 253 264 265 266 267 268

APPENDIX K: CLASSIFICATION OF CARD CONTENT FOR HYPOTHESES 12 - 15

12-15 - DEEMED BY EDUCATORS COMMON TO ALL SPECIALIZATIONS:

001 002 003 004 005 071 072 073 074 075 076 077
078 079 080 081 082 083 162 163 164 165 166 167
168 169 170 171 172 173 174 175 176 177 178 179
180 181 182 183 184 185 203 204 205 206 207 208
209 210 211 212 213 214 215 216 217 218 219 220
221 222 223 224 225 226 227 228

APPENDIX L: RESPONDENTS BY FIELD OF SPECIALIZATION

5.01 ARCHI	5.02 CIVIL /MUNICIP.	5.03 EL/EL	5.04 MECHA	5.05 STRUC	5.06 TOPOG	
	04	01	03	22	02	PRIMARY FIELD OF SPECIALIZATION IDENTIFIED BY RESPONDENT
	05	29	16	23	08	
	06	30	18	37	10	
	07	31	20	45	11	
	09	32	48	46	24	
	12	33	49	47	26	
	13	34	50	57	28	
	14	35	51	58	41	
	15	36	52			
	17	54	53			
	19	55	60			
	21	56				
	25	59				
	27					
	38					
	39					
	40					
	42					
	43					
	44					
n = 0	n = 20	n = 13	n = 11	n = 8	n = 8	n = 60
37	*23*		*57*		*12*	*Secondary Field of Specializ'n*
49	*30*		*58*		*13*	
53	*34*				*58*	
57	*41*					
58	*45*					
	46					
	47					
	57					
	58					
n = 5	*n = 9*	*n = 0*	*n = 2*	*n = 0*	*n = 3*	*n = 19*

APPENDIX M: CARD SORT CHECK LIST

RESPONDENT: ______________________________________ NUMBER: ______

	1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4
001					048					095					142					189					236				
002					049					096					143					190					237				
003					050					097					144					191					238				
004					051					098					145					192					239				
005					052					099					146					193					240				
006					053					100					147					194					241				
007					054					101					148					195					242				
008					055					102					149					196					243				
009					056					103					150					197					244				
010					057					104					151					198					245				
011					058					105					152					199					246				
012					059					106					153					200					247				
013					060					107					154					201					248				
014					061					108					155					202					249				
015					062					109					156					203					250				
016					063					110					157					204					251				
017					064					111					158					205					252				
018					065					112					159					206					253				
019					066					113					160					207					254				
020					067					114					161					208					255				
021					068					115					162					209					256				
022					069					116					163					210					257				
023					070					117					164					211					258				
024					071					118					165					212					259				
025					072					119					166					213					260				
026					073					120					167					214					261				
027					074					121					168					215					262				
028					075					122					169					216					263				
029					076					123					170					217					264				
030					077					124					171					218					265				
031					078					125					172					219					266				
032					079					126					173					220					267				
033					080					127					174					221					268				
034					081					128					175					222					269				
035					082					129					176					223					270				
036					083					130					177					224					271				
037					084					131					178					225					272				
038					085					132					179					226					273				
039					086					133					180					227					274				
040					087					134					181					228					275				
041					088					135					182					229					276				
042					089					136					183					230					277				
043					090					137					184					231					278				
044					091					138					185					232									
045					092					139					186					233									
046					093					140					187					234									
047					094					141					188					235									

1 = Essential
2 = Related
3 = Somewhat related
4 = Unrelated

APPENDIX N: CARD CHOICES "ESSENTIAL" AND "ESSENTIAL AND RELATED"

TABLE - CARD CHOICES BY ALL RESPONDENTS: "ESSENTIAL" AND "ESSENTIAL AND RELATED"

	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
CARD	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
001	27.3 (3)	25.0 (5)	17.5 (7)	20.0 (12)	54.5 (6)	40.0 (8)	42.5 (17)	41.7 (25)
002	27.3 (3)	20.0 (4)	20.0 (8)	20.0 (12)	54.5 (6)	35.0 (17)	40.0 (16)	38.3 (23)
003	27.3 (3)	5.0 (1)	12.5 (5)	10.0 (6)	54.5 (6)	25.0 (5)	27.5 (11)	26.7 (16)
004	9.1 (1)	5.0 (1)	2.5 (1)	3.3 (2)	18.2 (2)	5.0 (1)	7.5 (3)	6.7 (4)
005	9.1 (1)	(0)	5.0 (2)	3.3 (2)	36.4 (4)	5.0 (1)	15.0 (6)	11.7 (7)
006	18.2 (2)	15.0 (3)	7.5 (3)	10.0 (6)	45.4 (5)	45.0 (9)	27.5 (11)	33.3 (20)
007	36.4 (4)	15.0 (3)	2.5 (1)	6.7 (4)	45.4 (5)	40.0 (8)	20.0 (8)	26.7 (16)
008	27.3 (3)	5.0 (1)	5.0 (2)	5.0 (3)	45.4 (5)	40.0 (8)	17.5 (7)	25.0 (15)
009	27.3 (3)	10.0 (2)	5.0 (2)	6.7 (4)	45.4 (5)	45.0 (9)	22.5 (9)	30.0 (18)
010	36.4 (4)	15.0 (3)	2.5 (1)	6.7 (4)	54.5 (6)	45.0 (9)	15.0 (6)	25.0 (15)
011	9.1 (1)	20.0 (4)	2.5 (1)	8.3 (5)	36.4 (4)	30.0 (6)	7.5 (3)	15.0 (9)
012	27.3 (3)	5.0 (1)	2.5 (1)	3.3 (2)	45.4 (5)	10.0 (2)	2.5 (1)	5.0 (3)
013	36.4 (4)	5.0 (1)	2.5 (1)	3.3 (2)	54.5 (6)	15.0 (3)	2.5 (1)	6.7 (4)
014	18.2 (2)	(0)	2.5 (1)	1.7 (1)	45.4 (5)	10.0 (2)	2.5 (1)	5.0 (3)
015	36.4 (4)	(0)	2.5 (1)	1.7 (1)	54.5 (6)	25.0 (5)	2.5 (1)	10.0 (6)
016	9.1 (1)	(0)	(0)	(0)	54.5 (6)	10.0 (2)	5.0 (2)	6.7 (4)
017	9.1 (1)	5.0 (1)	(0)	1.7 (1)	54.5 (6)	10.0 (2)	(0)	3.3 (2)
018	9.1 (1)	(0)	2.5 (1)	1.7 (1)	63.6 (7)	20.0 (4)	7.5 (3)	11.7 (7)
019	63.6 (7)	55.0 (11)	40.0 (16)	45.0 (27)	63.6 (7)	80.0 (16)	72.5 (29)	75.0 (45)
020	63.6 (7)	65.0 (13)	50.0 (20)	55.0 (33)	81.8 (9)	85.0 (17)	77.5 (31)	80.0 (48)
021	72.7 (8)	70.0 (14)	42.5 (17)	51.7 (31)	72.7 (8)	80.0 (16)	72.5 (29)	75.0 (45)
022	63.6 (7)	50.0 (10)	40.0 (16)	43.3 (26)	72.7 (8)	70.0 (14)	55.0 (22)	60.0 (36)
023	54.5 (6)	45.0 (9)	40.0 (16)	41.7 (25)	72.7 (8)	60.0 (12)	60.0 (24)	60.0 (36)

TABLE - CONTINUED

CARD	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
024	45.4 (5)	40.0 (8)	40.0 (16)	40.0 (24)	72.7 (8)	50.0 (10)	52.5 (21)	51.7 (31)
025	45.4 (5)	60.0 (12)	52.5 (21)	55.0 (33)	90.9 (10)	75.0 (15)	62.5 (25)	66.7 (40)
026	45.4 (5)	50.0 (10)	30.0 (12)	36.7 (22)	90.9 (10)	65.0 (13)	47.5 (19)	53.3 (32)
027	(0)	(0)	(0)	(0)	18.2 (2)	5.0 (1)	5.0 (2)	5.0 (3)
028	(0)	(0)	(0)	(0)	(0)	(0)	2.5 (1)	1.7 (1)
029	(0)	(0)	(0)	(0)	(0)	(0)	5.0 (2)	3.3 (2)
030	(0)	(0)	(0)	(0)	18.2 (2)	5.0 (1)	5.0 (2)	5.0 (3)
031	27.3 (3)	(0)	(0)	(0)	27.3 (3)	15.0 (3)	12.5 (5)	13.3 (8)
032	18.2 (2)	(0)	7.5 (3)	5.0 (3)	36.4 (4)	10.0 (2)	12.5 (5)	11.7 (7)
033	36.4 (4)	30.0 (6)	12.5 (5)	18.3 (11)	63.6 (7)	55.0 (11)	40.0 (16)	45.0 (27)
034	(0)	(0)	2.5 (1)	1.7 (1)	27.3 (3)	15.0 (3)	20.0 (8)	18.3 (11)
035	(0)	(0)	(0)	(0)	18.2 (2)	10.0 (2)	7.5 (3)	8.3 (5)
036	9.1 (1)	25.0 (5)	5.0 (2)	11.7 (7)	18.2 (2)	50.0 (10)	17.5 (7)	28.3 (17)
037	36.4 (4)	35.0 (7)	12.5 (5)	20.0 (12)	72.7 (8)	65.0 (13)	47.5 (19)	53.3 (32)
038	(0)	5.0 (1)	5.0 (2)	5.0 (3)	27.3 (3)	20.0 (4)	12.5 (5)	15.0 (9)
039	9.1 (1)	40.0 (8)	17.5 (7)	25.0 (15)	27.3 (3)	60.0 (12)	25.0 (10)	36.7 (22)
040	36.4 (4)	50.0 (10)	40.0 (16)	43.3 (26)	54.5 (6)	60.0 (12)	55.0 (22)	56.7 (34)
041	63.6 (7)	65.0 (13)	47.5 (19)	53.3 (32)	81.8 (9)	80.0 (16)	80.0 (32)	80.0 (48)
042	9.1 (1)	45.0 (9)	32.5 (13)	36.7 (22)	81.8 (9)	60.0 (12)	62.5 (25)	61.7 (37)
043	(0)	25.0 (5)	2.5 (1)	10.0 (6)	45.4 (5)	45.0 (9)	27.5 (11)	33.3 (20)
044	(0)	45.0 (9)	25.0 (10)	31.7 (19)	72.7 (8)	70.0 (14)	50.0 (20)	56.7 (34)
045	(0)	35.0 (7)	22.5 (9)	26.7 (16)	63.6 (7)	55.0 (11)	47.5 (19)	50.0 (30)
046	18.2 (2)	45.0 (9)	20.0 (8)	28.3 (17)	54.5 (6)	60.0 (12)	37.5 (15)	45.0 (27)
047	9.1 (1)	5.0 (1)	5.0 (2)	5.0 (3)	36.4 (4)	35.0 (7)	10.0 (4)	18.3 (11)

TABLE - CONTINUED

CARD	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
048	9.1 (1)	25.0 (5)	22.5 (9)	23.3 (14)	45.4 (5)	45.0 (9)	42.5 (17)	43.3 (26)
049	27.3 (3)	60.0 (12)	42.5 (17)	48.3 (29)	72.7 (8)	85.0 (17)	75.0 (30)	78.3 (47)
050	18.2 (2)	30.0 (6)	7.5 (3)	15.0 (9)	45.4 (5)	45.0 (9)	30.0 (12)	35.0 (21)
051	18.2 (2)	30.0 (6)	5.0 (2)	13.3 (8)	45.4 (5)	40.0 (8)	25.0 (10)	30.0 (18)
052	9.1 (1)	30.0 (6)	5.0 (2)	13.3 (8)	45.4 (5)	40.0 (8)	20.0 (8)	26.7 (16)
053	(0)	15.0 (3)	2.5 (1)	6.7 (4)	27.3 (3)	30.0 (6)	7.5 (3)	15.0 (9)
054	45.4 (5)	40.0 (8)	30.0 (12)	33.3 (20)	63.6 (7)	50.0 (10)	52.5 (21)	51.7 (31)
055	45.4 (5)	50.0 (10)	32.5 (13)	38.3 (23)	63.6 (7)	60.0 (12)	42.5 (17)	48.3 (29)
056	36.4 (4)	35.0 (7)	27.5 (11)	30.0 (18)	63.6 (7)	70.0 (14)	50.0 (20)	56.7 (34)
057	9.1 (1)	20.0 (4)	10.0 (4)	13.3 (8)	36.4 (4)	40.0 (8)	20.0 (8)	26.7 (16)
058	(0)	5.0 (1)	5.0 (2)	5.0 (3)	9.1 (1)	5.0 (1)	17.5 (7)	13.3 (8)
059	18.2 (2)	5.0 (1)	5.0 (2)	5.0 (3)	18.2 (2)	15.0 (3)	15.0 (6)	15.0 (9)
060	9.1 (1)	(0)	5.0 (2)	3.3 (2)	18.2 (2)	20.0 (4)	10.0 (4)	13.3 (8)
061	9.1 (1)	(0)	2.5 (1)	1.7 (1)	18.2 (2)	10.0 (2)	15.0 (6)	13.3 (8)
062	(0)	(0)	2.5 (1)	1.7 (1)	27.3 (3)	5.0 (1)	10.0 (4)	8.3 (5)
063	9.1 (1)	5.0 (1)	5.0 (2)	5.0 (3)	36.4 (4)	25.0 (5)	20.0 (8)	21.7 (13)
064	(0)	10.0 (2)	2.5 (1)	5.0 (3)	9.1 (1)	20.0 (4)	10.0 (4)	13.3 (8)
065	9.1 (1)	(0)	(0)	(0)	9.1 (1)	5.0 (1)	5.0 (2)	5.0 (3)
066	9.1 (1)	(0)	2.5 (1)	1.7 (1)	27.3 (3)	5.0 (1)	5.0 (2)	5.0 (3)
067	27.3 (3)	15.0 (3)	5.0 (2)	8.3 (5)	45.4 (5)	5.0 (5)	22.5 (9)	23.3 (14)
068	9.1 (1)	(0)	(0)	(0)	27.3 (3)	10.0 (2)	7.5 (3)	8.3 (5)
069	9.1 (1)	(0)	2.5 (1)	1.7 (1)	36.4 (4)	5.0 (1)	10.0 (4)	8.3 (5)
070	(0)	(0)	2.5 (1)	1.7 (1)	9.1 (1)	(0)	2.5 (1)	1.7 (1)
071	90.9 (10)	85.0 (17)	85.0 (34)	85.0 (51)	100.0 (11)	100.0 (20)	92.5 (37)	95.0 (57)

TABLE - CONTINUED

CARD	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
072	36.4 (4)	65.0 (13)	67.5 (27)	66.7 (40)	72.7 (8)	95.0 (19)	90.0 (36)	91.7 (55)
073	63.6 (7)	90.0 (18)	85.0 (34)	86.7 (52)	72.7 (8)	100.0 (20)	92.5 (37)	95.0 (57)
074	90.9 (10)	100.0 (20)	87.5 (35)	91.7 (55)	100.0 (11)	100.0 (20)	92.5 (37)	95.0 (57)
075	81.8 (9)	85.0 (17)	45.0 (18)	58.3 (35)	100.0 (11)	85.0 (17)	65.0 (26)	71.7 (43)
076	18.2 (2)	45.0 (9)	17.5 (7)	26.7 (16)	72.7 (8)	60.0 (12)	37.5 (15)	45.0 (27)
077	45.4 (5)	40.0 (8)	30.0 (12)	33.3 (20)	54.5 (6)	70.0 (14)	50.0 (20)	56.7 (34)
078	90.9 (10)	95.0 (19)	82.5 (33)	86.7 (52)	81.8 (9)	100.0 (20)	95.0 (38)	96.7 (58)
079	81.8 (9)	80.0 (16)	55.0 (22)	63.3 (38)	72.7 (8)	85.0 (17)	80.0 (32)	81.7 (49)
080	27.3 (3)	40.0 (8)	30.0 (12)	33.3 (20)	72.7 (8)	55.0 (11)	60.0 (24)	58.3 (35)
081	9.1 (1)	45.0 (9)	15.0 (6)	25.0 (15)	45.4 (5)	65.0 (13)	32.5 (13)	43.3 (26)
082	9.1 (1)	65.0 (13)	40.0 (16)	48.3 (29)	45.4 (5)	85.0 (17)	60.0 (24)	68.3 (41)
083	27.3 (3)	70.0 (14)	37.5 (15)	48.3 (29)	54.5 (6)	90.0 (18)	65.0 (26)	73.3 (44)
084	18.2 (2)	50.0 (10)	27.5 (11)	35.0 (21)	72.7 (8)	65.0 (13)	40.0 (16)	48.3 (29)
085	36.4 (4)	45.0 (9)	20.0 (8)	28.3 (17)	81.8 (9)	60.0 (12)	37.5 (15)	45.0 (27)
086	54.5 (6)	55.0 (11)	30.0 (12)	38.3 (23)	63.6 (7)	75.0 (15)	42.5 (17)	53.3 (32)
087	63.6 (7)	55.0 (11)	37.5 (15)	43.3 (26)	72.7 (8)	65.0 (13)	47.5 (19)	53.3 (32)
088	63.6 (7)	50.0 (10)	22.5 (9)	31.7 (19)	72.7 (8)	75.0 (15)	35.0 (14)	48.3 (29)
089	36.4 (4)	45.0 (9)	20.0 (8)	28.3 (17)	63.6 (7)	65.0 (13)	32.5 (13)	43.3 (26)
090	9.1 (1)	20.0 (4)	15.0 (6)	16.7 (10)	63.6 (7)	45.0 (9)	27.5 (11)	33.3 (20)
091	18.2 (2)	20.0 (4)	10.0 (4)	13.3 (8)	45.4 (5)	35.0 (7)	25.0 (10)	28.3 (17)
092	9.1 (1)	20.0 (4)	12.5 (5)	15.0 (9)	45.4 (5)	30.0 (6)	25.0 (10)	26.7 (16)
093	9.1 (1)	20.0 (4)	15.0 (6)	16.7 (10)	63.6 (7)	40.0 (8)	25.0 (10)	30.0 (18)
094	27.3 (3)	25.0 (5)	17.5 (7)	20.0 (12)	45.4 (5)	40.0 (8)	25.0 (10)	30.0 (18)
095	9.1 (1)	10.0 (2)	17.5 (7)	15.0 (9)	36.4 (4)	40.0 (8)	22.5 (9)	28.3 (17)

TABLE - CONTINUFD

CARD	"ESSENTIAL" INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	"ESSENTIAL AND RELATED" INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
096	9.1 (1)	10.0 (2)	15.0 (6)	13.3 (8)	45.4 (5)	35.0 (7)	22.5 (9)	26.7 (16)
097	9.1 (1)	10.0 (2)	15.0 (6)	13.3 (8)	45.4 (5)	30.0 (6)	20.0 (8)	23.3 (14)
098	9.1 (1)	10.0 (2)	15.0 (6)	13.3 (8)	36.4 (4)	25.0 (5)	20.0 (8)	21.7 (13)
099	18.2 (2)	10.0 (2)	15.0 (6)	13.3 (8)	27.3 (3)	25.0 (5)	20.0 (8)	21.7 (13)
100	9.1 (1)	(0)	(0)	(0)	27.3 (3)	5.0 (1)	12.5 (5)	10.0 (6)
101	(0)	(0)	(0)	(0)	45.4 (5)	(0)	5.0 (2)	3.3 (2)
102	(0)	(0)	(0)	(0)	45.4 (5)	10.0 (2)	5.0 (2)	6.7 (4)
103	(0)	(0)	(0)	(0)	36.4 (4)	(0)	5.0 (2)	3.3 (2)
104	(0)	(0)	(0)	(0)	9.1 (1)	10.0 (2)	5.0 (2)	6.7 (4)
105	(0)	(0)	2.5 (1)	1.7 (1)	9.1 (1)	10.0 (2)	2.5 (1)	5.0 (3)
106	(0)	(0)	(0)	(0)	27.3 (3)	10.0 (2)	2.5 (1)	5.0 (3)
107	18.2 (2)	(0)	2.5 (1)	1.7 (1)	36.4 (4)	20.0 (4)	5.0 (2)	10.0 (6)
108	18.2 (2)	10.0 (2)	5.0 (2)	6.7 (4)	72.7 (8)	45.0 (9)	15.0 (6)	25.0 (15)
109	45.4 (5)	15.0 (3)	7.5 (3)	10.0 (6)	63.6 (7)	50.0 (10)	15.0 (6)	26.7 (16)
110	63.6 (7)	45.0 (9)	20.0 (8)	28.3 (17)	81.8 (9)	65.0 (13)	40.0 (16)	48.3 (29)
111	45.4 (5)	20.0 (4)	17.5 (7)	18.3 (11)	72.7 (8)	50.0 (10)	37.5 (15)	41.7 (25)
112	63.6 (7)	40.0 (8)	20.0 (8)	26.7 (16)	72.7 (8)	65.0 (13)	40.0 (16)	48.3 (29)
113	18.2 (2)	20.0 (4)	10.0 (4)	13.3 (8)	54.5 (6)	55.0 (11)	35.0 (14)	41.7 (25)
114	36.4 (4)	25.0 (5)	10.0 (4)	15.0 (9)	81.8 (9)	55.0 (11)	32.5 (13)	40.0 (24)
115	63.6 (7)	20.0 (4)	5.0 (2)	10.0 (6)	81.8 (9)	60.0 (12)	27.5 (11)	38.3 (23)
116	45.4 (5)	15.0 (3)	5.0 (2)	8.3 (5)	63.6 (7)	35.0 (7)	20.0 (8)	25.0 (15)
117	27.3 (3)	15.0 (3)	2.5 (1)	6.7 (4)	54.5 (6)	30.0 (6)	10.0 (4)	16.7 (10)
118	54.5 (6)	20.0 (4)	7.5 (3)	11.7 (7)	81.8 (9)	40.0 (8)	17.5 (7)	25.0 (15)
119	36.4 (4)	40.0 (8)	12.5 (5)	21.7 (13)	72.7 (8)	60.0 (12)	32.5 (13)	41.7 (25)

TABLE - CONTINUED

CARD	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
120	63.6 (7)	20.0 (4)	12.5 (5)	15.0 (9)	81.8 (9)	70.0 (14)	27.5 (11)	41.7 (25)
121	63.6 (7)	25.0 (5)	10.0 (4)	15.0 (9)	72.7 (8)	45.0 (9)	22.5 (9)	30.0 (18)
122	63.6 (7)	20.0 (4)	(0)	6.7 (4)	72.7 (8)	25.0 (5)	10.0 (4)	15.0 (9)
123	63.6 (7)	20.0 (4)	(0)	6.7 (4)	72.7 (8)	25.0 (5)	10.0 (4)	15.0 (9)
124	27.3 (3)	15.0 (3)	(0)	5.0 (3)	54.5 (6)	35.0 (7)	7.5 (3)	16.7 (10)
125	36.4 (4)	(0)	10.0 (4)	6.7 (4)	81.8 (9)	25.0 (5)	22.5 (9)	23.3 (14)
126	36.4 (4)	10.0 (2)	(0)	3.3 (2)	72.7 (8)	30.0 (6)	15.0 (6)	20.0 (12)
127	45.4 (5)	5.0 (1)	2.5 (1)	3.3 (2)	72.7 (8)	30.0 (6)	17.5 (7)	21.7 (13)
128	54.5 (6)	15.0 (3)	7.5 (3)	10.0 (6)	72.7 (8)	40.0 (8)	12.5 (5)	21.7 (13)
129	54.5 (6)	20.0 (4)	2.5 (1)	8.3 (5)	63.6 (7)	35.0 (7)	17.5 (7)	23.3 (14)
130	63.6 (7)	20.0 (4)	5.0 (2)	10.0 (6)	72.7 (8)	35.0 (7)	25.0 (10)	28.3 (17)
131	63.6 (7)	25.0 (5)	10.0 (4)	15.0 (9)	72.7 (8)	40.0 (8)	35.0 (14)	36.7 (22)
132	63.6 (7)	25.0 (5)	10.0 (4)	15.0 (9)	72.7 (8)	40.0 (8)	30.0 (12)	33.3 (20)
133	36.4 (4)	15.0 (3)	(0)	5.0 (3)	72.7 (8)	35.0 (7)	7.5 (3)	16.7 (10)
134	63.6 (7)	25.0 (5)	2.5 (1)	10.0 (6)	72.7 (8)	35.0 (7)	17.5 (7)	23.3 (14)
135	54.5 (6)	15.0 (3)	(0)	5.0 (3)	72.7 (8)	30.0 (6)	7.5 (3)	15.0 (9)
136	54.5 (6)	25.0 (5)	10.0 (4)	15.0 (9)	72.7 (8)	45.0 (9)	30.0 (12)	35.0 (21)
137	54.5 (6)	25.0 (5)	15.0 (6)	18.3 (11)	81.8 (9)	40.0 (8)	32.5 (13)	35.0 (21)
138	54.5 (6)	25.0 (5)	22.5 (9)	23.3 (14)	72.7 (8)	35.0 (7)	37.5 (15)	36.7 (22)
139	36.4 (4)	15.0 (3)	7.5 (3)	10.0 (6)	72.7 (8)	25.0 (5)	20.0 (8)	21.7 (13)
140	54.5 (6)	25.0 (5)	12.5 (5)	16.7 (10)	72.7 (8)	40.0 (8)	25.0 (10)	30.0 (18)
141	27.3 (3)	15.0 (3)	2.5 (1)	6.7 (4)	72.7 (8)	40.0 (8)	15.0 (6)	23.3 (14)
142	18.2 (2)	20.0 (4)	2.5 (1)	8.3 (5)	81.8 (9)	35.0 (7)	17.5 (7)	23.3 (14)
143	9.1 (1)	15.0 (3)	2.5 (1)	6.7 (4)	27.3 (3)	45.0 (9)	10.0 (4)	21.7 (13)

TABLE - CONTINUED

	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
CARD	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
144	18.2 (2)	10.0 (2)	2.5 (1)	5.0 (3)	63.6 (7)	25.0 (5)	10.0 (4)	15.0 (9)
145	45.4 (5)	20.0 (4)	2.5 (1)	8.3 (5)	63.6 (7)	35.0 (7)	12.5 (5)	20.0 (12)
146	45.4 (5)	15.0 (3)	(0)	5.0 (3)	54.5 (6)	30.0 (6)	10.0 (4)	16.7 (10)
147	45.4 (5)	30.0 (6)	20.0 (8)	23.3 (14)	81.8 (9)	50.0 (10)	32.5 (13)	38.3 (23)
148	45.4 (5)	25.0 (5)	2.5 (1)	10.0 (6)	81.8 (9)	45.0 (9)	17.5 (7)	26.7 (16)
149	18.2 (2)	30.0 (6)	2.5 (1)	11.7 (7)	54.5 (6)	45.0 (9)	10.0 (4)	21.7 (13)
150	27.3 (3)	5.0 (1)	(0)	1.7 (1)	63.6 (7)	15.0 (3)	2.5 (1)	6.7 (4)
151	36.4 (4)	25.0 (5)	12.5 (5)	16.7 (10)	63.6 (7)	35.0 (7)	37.5 (15)	36.7 (22)
152	9.1 (1)	20.0 (4)	17.5 (7)	18.3 (11)	63.6 (7)	45.0 (9)	32.5 (13)	36.7 (22)
153	9.1 (1)	15.0 (3)	20.0 (8)	18.3 (11)	54.5 (6)	35.0 (7)	35.0 (14)	35.0 (21)
154	27.3 (3)	5.0 (1)	12.5 (5)	10.0 (6)	81.8 (9)	25.0 (5)	30.0 (12)	28.3 (17)
155	(0)	5.0 (1)	7.5 (3)	6.7 (4)	36.4 (4)	5.0 (1)	20.0 (8)	15.0 (9)
156	9.1 (1)	5.0 (1)	5.0 (2)	5.0 (3)	45.4 (5)	15.0 (3)	12.5 (5)	13.3 (8)
157	18.2 (2)	10.0 (2)	17.5 (7)	15.0 (9)	36.4 (4)	25.0 (5)	27.5 (11)	26.7 (16)
158	9.1 (1)	5.0 (1)	(0)	1.7 (1)	18.2 (2)	10.0 (2)	7.5 (3)	8.3 (5)
159	9.1 (1)	15.0 (3)	10.0 (4)	11.7 (7)	27.3 (3)	20.0 (4)	20.0 (8)	20.0 (12)
160	36.4 (4)	10.0 (2)	15.0 (6)	13.3 (8)	54.5 (6)	20.0 (4)	27.5 (11)	25.0 (15)
161	36.4 (4)	15.0 (3)	10.0 (4)	11.7 (7)	45.4 (5)	15.0 (3)	20.0 (8)	18.3 (11)
162	27.3 (3)	10.0 (2)	7.5 (3)	8.3 (5)	54.5 (6)	40.0 (8)	20.0 (8)	26.7 (16)
163	9.1 (1)	10.0 (2)	2.5 (1)	5.0 (3)	45.4 (5)	40.0 (8)	12.5 (5)	21.7 (13)
164	(0)	5.0 (1)	(0)	1.7 (1)	18.2 (2)	20.0 (4)	5.0 (2)	10.0 (6)
165	(0)	5.0 (1)	(0)	1.7 (1)	18.2 (2)	20.0 (4)	5.0 (2)	10.0 (6)
166	27.3 (3)	35.0 (7)	17.5 (7)	23.3 (14)	90.9 (10)	65.0 (13)	52.5 (21)	56.7 (34)
167	(0)	10.0 (2)	5.0 (2)	6.7 (4)	9.1 (1)	35.0 (7)	22.5 (9)	26.7 (16)

TABLE - CONTINUED

CARD	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
168	(0)	25.5 (5)	12.5 (5)	16.7 (10)	27.3 (3)	50.0 (10)	20.0 (8)	30.0 (18)
169	27.3 (3)	45.0 (9)	37.5 (15)	40.0 (24)	63.6 (7)	85.0 (17)	77.5 (31)	80.0 (48)
170	(0)	10.0 (2)	7.5 (3)	8.3 (5)	27.3 (3)	20.0 (4)	25.0 (10)	23.3 (14)
171	27.3 (3)	40.0 (8)	37.5 (15)	38.3 (23)	63.6 (7)	70.0 (14)	62.5 (25)	31.7 (19)
172	9.1 (1)	20.0 (4)	12.5 (5)	15.0 (9)	27.3 (3)	50.0 (10)	32.5 (13)	38.3 (23)
173	27.3 (3)	45.0 (9)	25.0 (10)	31.7 (19)	63.6 (7)	75.0 (15)	55.0 (22)	61.7 (37)
174	(0)	20.0 (4)	7.5 (3)	11.7 (7)	45.4 (5)	40.0 (8)	20.0 (8)	26.7 (16)
175	(0)	20.0 (4)	2.5 (1)	8.3 (5)	27.3 (3)	45.0 (9)	10.0 (4)	21.7 (13)
176	9.1 (1)	30.0 (6)	15.0 (6)	20.0 (12)	45.4 (5)	45.0 (9)	25.0 (10)	31.7 (19)
177	9.1 (1)	20.0 (4)	5.0 (2)	10.0 (6)	9.1 (1)	35.0 (7)	22.5 (9)	26.7 (16)
178	9.1 (1)	25.0 (5)	7.5 (3)	13.3 (8)	27.3 (3)	45.0 (9)	27.5 (11)	33.3 (20)
179	18.2 (2)	30.0 (6)	15.0 (6)	20.0 (12)	36.4 (4)	50.0 (10)	30.0 (12)	36.7 (22)
180	18.2 (2)	30.0 (6)	10.0 (4)	16.7 (10)	63.6 (7)	45.0 (9)	25.0 (10)	31.7 (19)
181	9.1 (1)	10.0 (2)	5.0 (2)	6.7 (4)	27.3 (3)	30.0 (6)	15.0 (6)	20.0 (12)
182	9.1 (1)	15.0 (3)	5.0 (2)	8.3 (5)	45.4 (5)	30.0 (6)	10.0 (4)	16.7 (10)
183	9.1 (1)	5.0 (1)	(0)	1.7 (1)	18.2 (2)	10.0 (2)	7.5 (3)	8.3 (5)
184	27.3 (3)	35.0 (7)	17.5 (7)	23.3 (14)	54.5 (6)	50.0 (10)	27.5 (11)	35.0 (21)
185	9.1 (1)	15.0 (3)	(0)	5.0 (3)	27.3 (3)	20.0 (4)	10.0 (4)	13.3 (8)
186	27.3 (3)	35.0 (7)	20.0 (8)	25.0 (15)	81.8 (9)	60.0 (12)	45.0 (18)	50.0 (30)
187	36.4 (4)	50.0 (10)	37.5 (15)	41.7 (25)	72.7 (8)	85.0 (17)	57.5 (23)	66.7 (40)
188	36.4 (4)	55.0 (11)	35.0 (14)	41.7 (25)	81.8 (9)	70.0 (14)	62.5 (25)	65.0 (39)
189	36.4 (4)	55.0 (11)	32.5 (13)	40.0 (24)	81.8 (9)	65.0 (13)	55.0 (22)	58.3 (35)
190	18.2 (2)	35.0 (7)	17.5 (7)	23.3 (14)	63.6 (7)	55.0 (11)	32.5 (13)	40.0 (24)
191	27.3 (3)	40.0 (8)	20.0 (8)	26.7 (16)	72.7 (8)	65.0 (13)	32.5 (13)	43.3 (26)

TABLE - CONTINUED

CARD	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
192	36.4 (4)	45.0 (9)	30.0 (12)	35.0 (21)	72.7 (8)	60.0 (12)	42.5 (17)	48.3 (29)
193	18.2 (2)	25.0 (5)	17.5 (7)	20.0 (12)	54.5 (6)	40.0 (8)	32.5 (13)	35.0 (21)
194	(0)	35.0 (7)	12.5 (5)	20.0 (12)	36.4 (4)	45.0 (9)	27.5 (11)	33.3 (20)
195	(0)	25.0 (5)	5.0 (2)	11.7 (7)	18.2 (2)	35.0 (7)	17.5 (7)	23.3 (14)
196	27.3 (3)	45.0 (9)	15.0 (6)	25.0 (15)	63.6 (7)	50.0 (10)	32.5 (13)	38.3 (23)
197	(0)	20.0 (4)	2.5 (1)	8.3 (5)	27.3 (3)	40.0 (8)	15.0 (6)	23.3 (14)
198	(0)	5.0 (1)	2.5 (1)	3.3 (2)	9.1 (1)	20.0 (4)	10.0 (4)	13.3 (8)
199	45.4 (5)	50.0 (10)	30.0 (12)	36.7 (22)	63.6 (7)	55.0 (11)	47.5 (19)	50.0 (30)
200	54.5 (6)	50.0 (10)	30.0 (12)	36.7 (22)	72.7 (8)	50.0 (10)	40.0 (16)	43.3 (26)
201	54.5 (6)	45.0 (9)	30.0 (12)	35.0 (21)	72.7 (8)	50.0 (10)	40.0 (16)	43.3 (26)
202	45.4 (5)	30.0 (6)	17.5 (7)	21.7 (13)	72.7 (8)	40.0 (8)	35.0 (14)	36.7 (22)
203	9.1 (1)	40.0 (8)	55.0 (22)	50.0 (30)	54.5 (6)	90.0 (18)	70.0 (28)	76.7 (46)
204	18.2 (2)	55.0 (11)	47.5 (19)	50.0 (30)	54.5 (6)	80.0 (16)	65.0 (26)	70.0 (42)
205	18.2 (2)	70.0 (14)	37.5 (15)	48.3 (29)	72.7 (8)	95.0 (19)	65.0 (26)	75.0 (45)
206	54.5 (6)	60.0 (12)	27.5 (11)	38.3 (23)	81.8 (9)	90.0 (18)	45.0 (18)	60.0 (36)
207	27.3 (3)	35.0 (7)	10.0 (4)	18.3 (11)	90.9 (10)	60.0 (12)	25.0 (10)	36.7 (22)
208	(0)	5.0 (1)	2.5 (1)	3.3 (2)	36.4 (4)	10.0 (2)	12.5 (5)	11.7 (7)
209	36.4 (4)	55.0 (11)	12.5 (5)	26.7 (16)	54.5 (6)	85.0 (17)	35.0 (14)	51.7 (31)
210	54.5 (6)	45.0 (9)	37.5 (15)	40.0 (24)	81.8 (9)	80.0 (16)	55.0 (22)	63.3 (38)
211	36.4 (4)	35.0 (7)	27.5 (11)	30.0 (18)	72.7 (8)	60.0 (12)	45.0 (18)	50.0 (30)
212	36.4 (4)	50.0 (10)	25.0 (10)	33.3 (20)	72.7 (8)	90.0 (18)	47.5 (19)	61.7 (37)
213	36.4 (4)	10.0 (2)	12.5 (5)	11.7 (7)	81.8 (9)	35.0 (7)	25.0 (10)	28.3 (17)
214	18.2 (2)	5.0 (1)	5.0 (2)	5.0 (3)	45.4 (5)	5.0 (1)	12.5 (5)	10.0 (6)
215	45.4 (5)	75.0 (15)	55.0 (22)	61.7 (37)	72.7 (8)	95 (19)	85.0 (34)	88.3 (53)

TABLE - CONTINUED

CARD	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
216	18.2 (2)	15.0 (3)	2.5 (1)	6.7 (4)	45.4 (5)	40.0 (8)	17.5 (7)	25.0 (15)
217	18.2 (2)	15.0 (3)	2.5 (1)	6.7 (4)	27.3 (3)	40.0 (8)	12.5 (5)	21.7 (13)
218	9.1 (1)	5.0 (1)	5.0 (2)	5.0 (3)	9.1 (1)	15.0 (3)	7.5 (3)	10.0 (6)
219	9.1 (1)	10.0 (2)	7.5 (3)	8.3 (5)	45.4 (5)	30.0 (6)	17.5 (7)	21.7 (13)
220	18.2 (2)	5.0 (1)	7.5 (3)	6.7 (4)	54.5 (6)	15.0 (3)	22.5 (9)	20.0 (12)
221	9.1 (1)	(0)	2.5 (1)	1.7 (1)	18.2 (2)	(0)	5.0 (2)	3.3 (2)
222	18.2 (2)	15.0 (3)	12.5 (5)	13.3 (8)	54.5 (6)	40.0 (8)	35.0 (14)	36.7 (22)
223	18.2 (2)	15.0 (3)	15.0 (6)	15.0 (9)	72.7 (8)	45.0 (9)	45.0 (18)	45.0 (27)
224	(0)	10.0 (2)	5.0 (2)	6.7 (4)	18.2 (2)	10.0 (2)	17.5 (7)	15.0 (9)
225	9.1 (1)	15.0 (3)	12.5 (5)	13.3 (8)	45.4 (5)	45.0 (9)	32.5 (13)	36.7 (22)
226	9.1 (1)	10.0 (2)	10.0 (4)	10.0 (6)	45.4 (5)	15.0 (3)	17.5 (7)	16.7 (10)
227	(0)	15.0 (3)	10.0 (4)	11.7 (7)	18.2 (2)	25.0 (5)	25.0 (10)	25.0 (15)
228	(0)	20.0 (4)	2.5 (1)	8.3 (5)	18.2 (2)	30.0 (6)	15.0 (6)	20.0 (12)
229	36.4 (4)	5.0 (1)	10.0 (4)	8.3 (5)	45.4 (5)	15.0 (3)	22.5 (9)	20.0 (12)
230	36.4 (4)	10.0 (2)	7.5 (3)	8.3 (5)	36.4 (4)	20.0 (4)	17.5 (7)	18.3 (11)
231	27.3 (3)	10.0 (2)	5.0 (2)	6.7 (4)	36.4 (4)	15.0 (3)	17.5 (7)	16.7 (10)
232	27.3 (3)	5.0 (1)	5.0 (2)	5.0 (3)	45.4 (5)	10.0 (2)	12.5 (5)	11.7 (7)
233	9.1 (1)	10.0 (2)	2.5 (1)	5.0 (3)	18.2 (2)	15.0 (3)	12.5 (5)	13.3 (8)
234	9.1 (1)	5.0 (1)	2.5 (1)	3.3 (2)	36.4 (4)	15.0 (3)	12.5 (5)	13.3 (8)
235	18.2 (2)	15.0 (3)	2.5 (1)	6.7 (4)	45.4 (5)	20.0 (4)	17.5 (7)	18.3 (11)
236	18.2 (2)	10.0 (2)	2.5 (1)	5.0 (3)	36.4 (4)	20.0 (4)	15.0 (6)	16.7 (10)
237	9.1 (1)	10.0 (2)	2.5 (1)	5.0 (3)	9.1 (1)	20.0 (4)	10.0 (4)	13.3 (8)
238	(0)	5.0 (1)	2.5 (1)	3.3 (2)	18.2 (2)	15.0 (3)	12.5 (5)	13.3 (8)
239	18.2 (2)	5.0 (1)	5.0 (2)	5.0 (3)	36.4 (4)	25.0 (5)	15.0 (6)	18.3 (11)

TABLE - CONTINUED

CARD	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
240	18.2 (2)	10.0 (2)	5.0 (2)	6.7 (4)	45.4 (5)	15.0 (3)	12.5 (5)	13.3 (8)
241	(0)	5.0 (1)	5.0 (2)	5.0 (3)	9.1 (1)	20.0 (4)	12.5 (5)	15.0 (9)
242	(0)	5.0 (1)	2.5 (1)	3.3 (2)	27.3 (3)	20.0 (4)	10.0 (4)	13.3 (8)
243	(0)	5.0 (1)	5.0 (2)	5.0 (3)	27.3 (3)	20.0 (4)	17.5 (7)	18.3 (11)
244	9.1 (1)	5.0 (1)	2.5 (1)	3.3 (2)	27.3 (3)	30.0 (6)	17.5 (7)	21.7 (13)
245	(0)	(0)	5.0 (2)	3.3 (2)	27.3 (3)	15.0 (3)	12.5 (5)	13.3 (8)
246	9.1 (1)	5.0 (1)	12.5 (5)	10.0 (6)	45.4 (5)	25.0 (5)	25.0 (10)	25.0 (15)
247	9.1 (1)	(0)	(0)	(0)	18.2 (2)	5.0 (1)	5.0 (2)	5.0 (3)
248	27.3 (3)	15.0 (3)	7.5 (3)	10.0 (6)	90.9 (10)	35.0 (7)	15.0 (6)	21.7 (13)
249	18.2 (2)	20.0 (4)	2.5 (1)	8.3 (5)	81.8 (9)	35.0 (7)	10.0 (4)	18.3 (11)
250	27.3 (3)	15.0 (3)	(0)	5.0 (3)	81.8 (9)	35.0 (7)	2.5 (1)	13.3 (8)
251	27.3 (3)	15.0 (3)	(0)	5.0 (3)	72.7 (8)	30.0 (6)	7.5 (3)	15.0 (9)
252	36.4 (4)	5.0 (1)	7.5 (3)	6.7 (4)	54.5 (6)	20.0 (4)	12.5 (5)	15.0 (9)
253	45.4 (5)	55.0 (11)	42.5 (17)	46.7 (28)	100.0 (11)	75.0 (15)	75.0 (30)	75.0 (45)
254	27.3 (3)	10.0 (2)	10.0 (4)	10.0 (6)	63.6 (7)	30.0 (6)	17.5 (7)	21.7 (13)
255	9.1 (1)	10.0 (2)	10.0 (4)	10.0 (6)	63.6 (7)	25.0 (5)	20.0 (8)	21.7 (13)
256	9.1 (1)	10.0 (2)	5.0 (2)	6.7 (4)	63.6 (7)	25.0 (5)	22.5 (9)	23.3 (14)
257	27.3 (3)	5.0 (1)	10.0 (4)	8.3 (5)	81.8 (9)	20.0 (4)	10.0 (4)	13.3 (8)
258	36.4 (4)	10.0 (2)	10.0 (4)	10.0 (6)	72.7 (8)	20.0 (4)	12.5 (5)	15.0 (9)
259	36.4 (4)	5.0 (1)	7.5 (3)	6.7 (4)	72.7 (8)	20.0 (4)	12.5 (5)	15.0 (9)
260	27.3 (3)	25.0 (5)	17.5 (7)	20.0 (12)	54.5 (6)	40.0 (8)	25.0 (10)	30.0 (18)
261	36.4 (4)	15.0 (3)	12.5 (5)	13.3 (8)	63.6 (7)	30.0 (6)	17.5 (7)	21.7 (13)
262	36.4 (4)	15.0 (3)	7.5 (3)	10.0 (6)	72.7 (8)	30.0 (6)	17.5 (7)	21.7 (13)
263	18.2 (2)	(0)	10.0 (4)	6.7 (4)	54.5 (6)	25.0 (5)	22.5 (9)	23.3 (14)

TABLE - CONTINUED

CARD	"ESSENTIAL"				"ESSENTIAL AND RELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
264	54.5 (6)	35.0 (7)	15.0 (6)	21.7 (13)	100.0 (11)	55.0 (11)	40.0 (16)	45.0 (27)
265	45.4 (5)	35.0 (7)	5.0 (2)	15.0 (9)	100.0 (11)	55.0 (11)	35.0 (14)	41.7 (25)
266	63.6 (7)	40.0 (8)	12.5 (5)	21.7 (13)	100.0 (11)	70.0 (14)	42.5 (17)	51.7 (31)
267	54.5 (6)	30.0 (6)	5.0 (2)	13.3 (8)	100.0 (11)	55.0 (11)	40.0 (16)	45.0 (27)
268	54.5 (6)	45.0 (9)	20.0 (8)	28.3 (17)	81.8 (9)	70.0 (14)	50.0 (20)	56.7 (34)
269	9.1 (1)	20.0 (4)	7.5 (3)	11.7 (7)	54.5 (6)	25.0 (5)	20.0 (8)	21.7 (13)
270	(0)	25.0 (5)	12.5 (5)	16.7 (10)	45.4 (5)	35.0 (7)	20.0 (8)	25.0 (15)
271	9.1 (1)	25.0 (5)	10.0 (4)	15.0 (9)	45.4 (5)	25.0 (5)	20.0 (8)	21.7 (13)
272	9.1 (1)	(0)	2.5 (1)	1.7 (1)	36.4 (4)	10.0 (2)	7.5 (3)	8.3 (5)
273	27.3 (3)	5.0 (1)	12.5 (5)	10.0 (6)	72.7 (8)	20.0 (4)	15.0 (6)	16.7 (10)
274	27.3 (3)	15.0 (3)	20.0 (8)	18.3 (11)	72.7 (8)	35.0 (7)	30.0 (12)	31.7 (19)
275	27.3 (3)	15.0 (3)	17.5 (7)	16.7 (10)	72.7 (8)	55.0 (11)	25.0 (10)	35.0 (21)
276	(0)	5.0 (1)	10.0 (4)	8.3 (5)	63.6 (7)	20.0 (4)	12.5 (5)	15.0 (9)
277	18.2 (2)	(0)	7.5 (3)	5.0 (3)	72.7 (8)	25.0 (5)	25.0 (10)	25.0 (15)
278	18.2 (2)	5.0 (1)	2.5 (1)	3.3 (2)	45.4 (5)	10.0 (2)	7.5 (3)	8.3 (5)

APPENDIX O: CARD CHOICES "RELATED AND SOMEWHAT RELATED" AND "UNRELATED"

TABLE - CARD CHOICES BY ALL RESPONDENTS: "RELATED AND SOMEWHAT RELATED" AND "UNRELATED"

	"RELATED AND SOMEWHAT RELATED"				"UNRELATED"			
CARD	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
001	45.5 (5)	55.0 (11)	60.0 (24)	58.3 (35)	27.3 (3)	20.0 (4)	22.5 (9)	21.7 (13)
002	54.5 (6)	60.0 (12)	57.5 (23)	58.3 (35)	18.2 (2)	20.0 (4)	22.5 (9)	21.7 (13)
003	45.4 (5)	70.0 (14)	52.5 (21)	58.3 (35)	27.3 (3)	25.0 (5)	35.0 (14)	31.7 (19)
004	36.4 (4)	25.0 (5)	20.0 (8)	21.7 (13)	54.5 (6)	70.0 (14)	77.5 (31)	75.0 (45)
005	45.4 (5)	30.0 (6)	22.5 (9)	25.0 (15)	45.4 (5)	70.0 (14)	72.5 (29)	71.7 (43)
006	72.7 (8)	50.0 (10)	52.5 (21)	51.7 (31)	9.1 (1)	35.0 (7)	40.0 (16)	38.3 (23)
007	45.5 (5)	50.0 (10)	45.0 (18)	46.7 (28)	18.2 (2)	35.0 (7)	52.5 (21)	46.7 (28)
008	54.5 (6)	60.0 (12)	47.5 (19)	51.7 (31)	18.2 (2)	35.0 (7)	47.5 (19)	43.3 (26)
009	54.5 (6)	60.0 (12)	42.5 (17)	48.3 (29)	18.2 (2)	30.0 (6)	52.5 (21)	45.0 (27)
010	45.4 (5)	55.0 (11)	37.5 (15)	43.3 (26)	18.2 (2)	30.0 (6)	60.0 (24)	50.0 (30)
011	72.7 (8)	45.0 (9)	27.5 (11)	33.3 (20)	18.2 (2)	35.0 (7)	70.0 (28)	58.3 (35)
012	36.4 (4)	50.0 (10)	35.0 (14)	40.0 (24)	36.4 (4)	45.0 (9)	62.5 (25)	56.7 (34)
013	36.4 (4)	45.0 (9)	27.5 (11)	33.3 (20)	27.3 (3)	50.0 (10)	70.0 (28)	63.3 (38)
014	45.4 (5)	30.0 (6)	12.5 (5)	18.3 (11)	36.4 (4)	70.0 (14)	85.0 (34)	80.0 (48)
015	36.4 (4)	50.0 (10)	25.0 (10)	33.3 (20)	27.3 (3)	50.0 (10)	72.5 (29)	65.0 (39)
016	45.5 (5)	40.0 (8)	12.5 (5)	21.7 (13)	45.5 (5)	60.0 (12)	87.5 (35)	78.3 (47)
017	72.7 (8)	25.0 (5)	22.5 (9)	23.3 (14)	18.2 (2)	70.0 (14)	77.5 (31)	75.0 (45)
018	72.7 (8)	30.0 (6)	27.5 (11)	28.3 (17)	18.2 (2)	70.0 (14)	70.0 (28)	70.0 (42)
019	18.2 (2)	40.0 (8)	55.0 (22)	50.0 (30)	18.2 (2)	5.0 (1)	5.0 (2)	5.0 (3)
020	27.3 (3)	35.0 (7)	45.0 (18)	41.7 (25)	9.1 (1)	(0)	5.0 (2)	3.3 (2)
021	18.2 (2)	15.0 (3)	47.5 (19)	36.7 (22)	9.1 (1)	15.0 (3)	10.0 (4)	11.7 (7)
022	27.3 (3)	35.0 (7)	40.0 (16)	38.3 (23)	18.2 (2)	15.0 (3)	20.0 (8)	18.3 (11)
023	27.3 (3)	35.0 (7)	32.5 (13)	33.3 (20)	18.2 (2)	20.0 (4)	27.5 (11)	25.0 (15)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED"				"UNRELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
024	36.4 (4)	40.0 (8)	30.0 (12)	33.3 (20)	18.2 (2)	20.0 (4)	30.0 (12)	26.7 (16)
025	54.5 (6)	25.0 (5)	30.0 (12)	28.3 (17)	(0)	15.0 (3)	17.5 (7)	16.7 (10)
026	54.5 (6)	35.0 (7)	37.5 (15)	36.7 (22)	(0)	15.0 (3)	32.5 (13)	26.7 (16)
027	36.4 (4)	45.0 (9)	32.5 (13)	36.7 (22)	63.6 (7)	55.0 (11)	67.5 (27)	63.3 (38)
028	36.4 (4)	15.0 (3)	10.0 (4)	11.7 (7)	63.6 (7)	85.0 (17)	90.0 (36)	88.3 (53)
029	54.5 (6)	25.0 (5)	27.5 (11)	26.7 (16)	45.4 (5)	75.0 (15)	72.5 (29)	73.3 (44)
030	36.4 (4)	30.0 (6)	27.5 (11)	28.3 (17)	63.6 (7)	70.0 (14)	72.5 (29)	71.7 (43)
031	27.3 (3)	50.0 (10)	47.5 (19)	48.3 (29)	45.4 (5)	50.0 (10)	52.5 (21)	51.7 (31)
032	27.3 (3)	35.0 (7)	37.5 (15)	36.7 (22)	54.5 (6)	65.0 (13)	55.0 (22)	58.3 (35)
033	36.4 (4)	60.0 (12)	62.5 (25)	28.3 (37)	27.3 (3)	10.0 (2)	25.0 (10)	20.0 (12)
034	72.7 (8)	45.0 (9)	37.5 (15)	40.0 (24)	27.3 (3)	55.0 (11)	60.0 (24)	58.3 (35)
035	54.5 (6)	25.0 (5)	27.5 (11)	26.7 (16)	45.4 (5)	75.0 (15)	72.5 (29)	73.3 (44)
036	63.6 (7)	45.0 (9)	47.5 (19)	46.7 (28)	27.3 (3)	30.0 (6)	47.5 (19)	41.7 (25)
037	45.4 (5)	50.0 (10)	62.5 (25)	58.3 (35)	18.2 (2)	15.0 (3)	25.0 (10)	21.7 (13)
038	63.6 (7)	45.0 (9)	27.5 (11)	33.3 (20)	36.4 (4)	50.0 (10)	67.5 (27)	61.7 (37)
039	72.7 (8)	30.0 (6)	47.5 (19)	41.7 (25)	18.2 (2)	30.0 (6)	35.0 (14)	33.3 (20)
040	36.4 (4)	25.0 (5)	40.0 (16)	35.0 (21)	27.3 (3)	25.0 (5)	20.0 (8)	21.7 (13)
041	18.2 (2)	30.0 (6)	45.0 (18)	40.0 (24)	18.2 (2)	5.0 (1)	7.5 (3)	6.7 (4)
042	81.8 (9)	40.0 (8)	50.0 (20)	46.7 (28)	9.1 (1)	15.0 (3)	17.5 (7)	16.7 (10)
043	81.8 (9)	40.0 (8)	45.0 (18)	43.3 (26)	18.2 (2)	35.0 (7)	52.5 (21)	46.7 (28)
044	90.9 (10)	35.0 (7)	52.5 (21)	46.7 (28)	9.1 (1)	20.0 (4)	22.5 (9)	21.7 (13)
045	72.7 (8)	40.0 (8)	47.5 (19)	45.0 (27)	27.3 (3)	25.0 (5)	30.0 (12)	28.3 (17)
046	63.6 (7)	35.0 (7)	45.0 (18)	41.7 (25)	18.2 (2)	20.0 (4)	35.0 (14)	30.0 (18)
047	63.6 (7)	45.0 (9)	42.5 (17)	43.3 (26)	27.3 (3)	50.0 (10)	52.5 (21)	51.7 (31)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED"				"UNRELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
048	54.5 (6)	25.0 (5)	40.0 (16)	35.0 (21)	36.4 (4)	50.0 (10)	37.5 (15)	41.7 (25)
049	63.6 (7)	40.0 (8)	52.5 (21)	48.3 (29)	9.1 (1)	(0)	5.0 (2)	3.3 (2)
050	54.5 (6)	35.0 (7)	45.0 (18)	41.7 (25)	27.3 (3)	35.0 (7)	47.5 (19)	43.3 (26)
051	45.4 (5)	35.0 (7)	55.0 (22)	48.3 (29)	36.4 (4)	35.0 (7)	40.0 (16)	38.3 (23)
052	63.6 (7)	25.0 (5)	52.5 (21)	43.3 (26)	27.3 (3)	45.0 (9)	42.5 (17)	43.3 (26)
053	63.6 (7)	40.0 (8)	35.0 (14)	36.7 (22)	36.4 (4)	45.0 (9)	62.5 (25)	56.7 (34)
054	36.4 (4)	25.0 (5)	40.0 (16)	35.0 (21)	18.2 (2)	35.0 (7)	30.0 (12)	31.7 (19)
055	36.4 (4)	15.0 (3)	37.5 (15)	30.0 (18)	18.2 (2)	35.0 (7)	30.0 (12)	31.7 (19)
056	45.4 (5)	50.0 (10)	50.0 (20)	50.0 (30)	18.2 (2)	15.0 (3)	22.5 (9)	20.0 (12)
057	63.6 (7)	45.0 (9)	30.0 (12)	35.0 (21)	27.3 (3)	35.0 (7)	60.0 (24)	51.7 (31)
058	45.4 (5)	25.0 (5)	27.5 (11)	26.7 (16)	54.5 (6)	70.0 (14)	67.5 (27)	68.3 (41)
059	27.3 (3)	30.0 (6)	30.0 (12)	30.0 (18)	54.5 (6)	65.0 (13)	65.0 (26)	65.0 (39)
060	36.4 (4)	40.0 (8)	22.5 (9)	28.3 (17)	54.5 (6)	60.0 (12)	72.5 (29)	68.3 (41)
061	36.4 (4)	40.0 (8)	25.0 (10)	30.0 (18)	54.5 (6)	60.0 (12)	72.5 (29)	68.3 (41)
062	45.4 (5)	25.0 (5)	17.5 (7)	20.0 (12)	54.5 (6)	75.0 (15)	80.0 (32)	78.3 (47)
063	36.4 (4)	50.0 (10)	50.0 (20)	50.0 (30)	54.5 (6)	45.0 (9)	45.0 (18)	45.0 (27)
064	27.3 (3)	25.0 (5)	15.0 (6)	18.3 (11)	72.7 (8)	65.0 (13)	82.5 (33)	76.7 (46)
065	36.4 (4)	30.0 (6)	15.0 (6)	20.0 (12)	54.5 (6)	70.0 (14)	85.0 (34)	80.0 (48)
066	36.4 (4)	20.0 (4)	17.5 (7)	18.3 (11)	54.5 (6)	80.0 (16)	80.0 (32)	80.0 (48)
067	27.3 (3)	30.0 (6)	42.5 (17)	38.3 (23)	45.4 (5)	55.0 (11)	52.5 (21)	53.3 (32)
068	45.4 (5)	25.0 (5)	22.5 (9)	23.3 (14)	45.4 (5)	75.0 (15)	77.5 (31)	76.7 (46)
069	36.4 (4)	30.0 (6)	12.5 (5)	18.3 (11)	54.5 (6)	70.0 (14)	85.0 (34)	80.0 (48)
070	63.6 (7)	25.0 (5)	17.5 (7)	20.0 (12)	36.4 (4)	75.0 (15)	80.0 (32)	78.3 (47)
071	9.1 (1)	15.0 (3)	12.5 (5)	13.3 (8)	(0)	(0)	2.5 (1)	1.7 (1)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED" INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	"UNRELATED" INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
072	54.5 (6)	35.0 (7)	30.0 (12)	31.7 (19)	9.1 (1)	(0)	2.5 (1)	1.7 (1)
073	27.3 (3)	10.0 (2)	10.0 (4)	10.0 (6)	9.1 (1)	(0)	5.0 (2)	3.4 (2)
074	9.1 (1)	(0)	10.0 (4)	6.7 (4)	(0)	(0)	2.5 (1)	1.7 (1)
075	18.2 (2)	10.0 (2)	32.5 (13)	25.0 (15)	(0)	5.0 (1)	22.5 (9)	16.7 (10)
076	63.6 (7)	45.0 (9)	55.0 (22)	51.7 (31)	18.2 (2)	10.0 (2)	27.5 (11)	21.7 (13)
077	54.5 (6)	55.0 (11)	50.0 (20)	51.7 (31)	(0)	5.0 (1)	20.0 (8)	15.0 (9)
078	9.1 (1)	5.0 (1)	15.0 (6)	11.7 (7)	(0)	(0)	2.5 (1)	1.7 (1)
079	9.1 (1)	15.0 (3)	35.0 (14)	28.3 (17)	9.1 (1)	5.0 (1)	10.0 (4)	8.3 (5)
080	63.6 (7)	45.0 (9)	60.0 (24)	55.0 (33)	9.1 (1)	15.0 (3)	10.0 (4)	11.7 (7)
081	63.6 (7)	40.0 (8)	50.0 (20)	46.7 (28)	27.3 (3)	15.0 (3)	35.0 (14)	28.3 (17)
082	63.6 (7)	30.0 (6)	45.0 (18)	40.0 (24)	27.3 (3)	5.0 (1)	15.0 (6)	11.7 (7)
083	72.7 (8)	25.0 (5)	47.5 (19)	40.0 (24)	(0)	5.0 (1)	15.0 (6)	11.7 (7)
084	72.7 (8)	30.0 (6)	32.5 (13)	31.7 (19)	9.1 (1)	20.0 (4)	40.0 (16)	33.3 (20)
085	54.5 (6)	35.0 (7)	40.0 (16)	38.3 (23)	9.1 (1)	20.0 (4)	40.0 (16)	33.3 (20)
086	18.2 (2)	25.0 (5)	47.5 (19)	40.0 (24)	27.3 (3)	20.0 (4)	22.5 (9)	21.7 (13)
087	27.3 (3)	25.0 (5)	35.0 (14)	31.7 (19)	9.1 (1)	20.0 (4)	27.5 (11)	25.0 (15)
088	27.3 (3)	30.0 (6)	42.5 (17)	38.3 (23)	9.1 (1)	20.0 (4)	35.0 (14)	30.0 (18)
089	54.5 (6)	30.0 (6)	45.0 (18)	40.0 (24)	9.1 (1)	25.0 (5)	35.0 (14)	31.7 (19)
090	63.6 (7)	40.0 (8)	25.0 (10)	30.0 (18)	27.3 (3)	40.0 (8)	60.0 (24)	53.3 (32)
091	54.5 (6)	35.0 (7)	20.0 (8)	25.0 (15)	27.3 (3)	45.0 (9)	70.0 (28)	61.7 (37)
092	72.7 (8)	35.0 (7)	25.0 (10)	28.3 (17)	18.2 (2)	45.0 (9)	62.5 (25)	56.7 (34)
093	72.7 (8)	40.0 (8)	27.5 (11)	31.7 (19)	18.2 (2)	40.0 (8)	57.5 (23)	51.7 (31)
094	36.4 (4)	40.0 (8)	30.0 (12)	33.3 (20)	36.4 (4)	35.0 (7)	52.5 (21)	46.7 (28)
095	54.5 (6)	50.0 (10)	22.5 (9)	31.7 (19)	36.4 (4)	40.0 (8)	60.0 (24)	53.3 (32)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED"				"UNRELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
096	54.5 (6)	30.0 (6)	20.0 (8)	23.3 (14)	36.4 (4)	60.0 (12)	65.0 (26)	63.3 (38)
097	54.5 (6)	30.0 (6)	10.0 (4)	16.7 (10)	36.4 (4)	60.0 (12)	75.0 (30)	70.0 (42)
098	54.5 (6)	30.0 (6)	15.0 (6)	20.0 (12)	36.4 (4)	60.0 (12)	70.0 (28)	66.7 (40)
099	54.5 (6)	30.0 (6)	10.0 (4)	16.7 (10)	27.3 (3)	60.0 (12)	75.0 (30)	70.0 (42)
100	36.4 (4)	30.0 (6)	15.0 (6)	20.0 (12)	54.5 (6)	70.0 (14)	85.0 (34)	80.0 (48)
101	63.6 (7)	30.0 (6)	17.5 (7)	21.7 (13)	36.4 (4)	70.0 (14)	82.5 (33)	78.3 (47)
102	63.6 (7)	35.0 (7)	17.5 (7)	23.3 (14)	36.4 (4)	65.0 (13)	82.5 (33)	76.7 (46)
103	54.5 (6)	30.0 (6)	17.5 (7)	21.7 (13)	45.4 (5)	70.0 (14)	82.5 (33)	78.3 (47)
104	63.6 (7)	25.0 (5)	10.0 (4)	15.0 (9)	36.4 (4)	75.0 (15)	90.0 (36)	85.0 (51)
105	54.5 (6)	20.0 (4)	12.5 (5)	15.0 (9)	45.4 (5)	80.0 (16)	85.0 (34)	83.3 (50)
106	63.6 (7)	20.0 (4)	12.5 (5)	15.0 (9)	36.4 (4)	80.0 (16)	87.5 (35)	85.0 (51)
107	27.3 (3)	40.0 (8)	20.0 (8)	26.7 (16)	54.5 (6)	60.0 (12)	77.5 (31)	71.7 (43)
108	72.7 (8)	60.0 (12)	50.0 (20)	53.3 (32)	9.1 (1)	30.0 (6)	45.0 (18)	40.0 (24)
109	45.4 (5)	65.0 (13)	42.5 (17)	50.0 (30)	9.1 (1)	20.0 (4)	50.0 (20)	40.0 (24)
110	18.2 (2)	30.0 (6)	42.5 (17)	38.3 (23)	18.2 (2)	25.0 (5)	37.5 (15)	33.3 (20)
111	27.3 (3)	45.0 (9)	37.5 (15)	40.0 (24)	27.3 (3)	35.0 (7)	45.0 (18)	41.7 (25)
112	9.1 (1)	40.0 (8)	47.5 (19)	45.0 (27)	27.3 (3)	20.0 (4)	32.5 (13)	28.3 (17)
113	63.6 (7)	55.0 (11)	42.5 (17)	46.7 (28)	18.2 (2)	25.0 (5)	47.5 (19)	40.0 (24)
114	54.5 (6)	50.0 (10)	35.0 (14)	40.0 (24)	9.1 (1)	25.0 (5)	55.0 (22)	45.0 (27)
115	27.3 (3)	60.0 (12)	42.5 (17)	48.3 (29)	9.1 (1)	20.0 (4)	52.5 (21)	41.7 (25)
116	45.4 (5)	50.0 (10)	42.5 (17)	45.0 (27)	9.1 (1)	35.0 (7)	52.5 (21)	46.7 (28)
117	45.4 (5)	50.0 (10)	45.0 (18)	46.7 (28)	27.3 (3)	35.0 (7)	52.5 (21)	46.7 (28)
118	27.3 (3)	40.0 (8)	40.0 (16)	40.0 (24)	18.2 (2)	40.0 (8)	52.5 (21)	48.3 (29)
119	54.5 (6)	35.0 (7)	37.5 (15)	36.7 (22)	9.1 (1)	25.0 (5)	50.0 (20)	41.7 (25)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED"				"UNRELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
120	18.2 (2)	50.0 (10)	40.0 (16)	43.3 (26)	18.2 (2)	30.0 (6)	47.5 (19)	41.7 (25)
121	18.2 (2)	50.0 (10)	45.0 (18)	46.7 (28)	18.2 (2)	25.0 (5)	45.0 (18)	38.3 (23)
122	18.2 (2)	35.0 (7)	32.5 (13)	33.3 (20)	18.2 (2)	45.0 (9)	67.5 (27)	60.0 (36)
123	18.2 (2)	45.0 (9)	40.0 (16)	41.7 (25)	18.2 (2)	35.0 (7)	60.0 (24)	51.7 (31)
124	54.5 (6)	45.0 (9)	40.0 (16)	41.7 (25)	18.2 (2)	40.0 (8)	60.0 (24)	53.3 (32)
125	45.4 (5)	60.0 (12)	30.0 (12)	40.0 (24)	18.2 (2)	40.0 (8)	60.0 (24)	53.3 (32)
126	45.4 (5)	40.0 (8)	40.0 (16)	40.0 (24)	18.2 (2)	50.0 (10)	60.0 (24)	56.7 (34)
127	27.3 (3)	50.0 (10)	35.0 (14)	40.0 (24)	27.3 (3)	45.0 (9)	62.5 (25)	56.7 (34)
128	18.2 (2)	45.0 (9)	35.0 (14)	38.3 (23)	27.3 (3)	40.0 (8)	57.5 (23)	51.7 (31)
129	18.2 (2)	30.0 (6)	40.0 (16)	36.7 (22)	27.3 (3)	50.0 (10)	57.5 (23)	55.0 (33)
130	18.2 (2)	40.0 (8)	55.0 (22)	50.0 (30)	18.2 (2)	40.0 (8)	40.0 (16)	40.0 (24)
131	18.2 (2)	45.0 (9)	50.0 (20)	48.3 (29)	18.2 (2)	30.0 (6)	40.0 (16)	36.7 (22)
132	18.2 (2)	50.0 (10)	47.5 (19)	48.3 (29)	18.2 (2)	25.0 (5)	42.5 (17)	36.7 (22)
133	36.4 (4)	30.0 (6)	40.0 (16)	36.7 (22)	27.3 (3)	55.0 (11)	60.0 (24)	58.3 (35)
134	9.1 (1)	40.0 (8)	40.0 (16)	40.0 (24)	27.3 (3)	35.0 (7)	57.5 (23)	50.0 (30)
135	18.2 (2)	40.0 (8)	35.0 (14)	36.7 (22)	27.3 (3)	45.0 (9)	65.0 (26)	58.3 (35)
136	27.3 (3)	50.0 (10)	50.0 (20)	50.0 (30)	18.2 (2)	25.0 (5)	40.0 (16)	35.0 (21)
137	36.4 (4)	45.0 (9)	40.0 (16)	41.7 (25)	9.1 (1)	30.0 (6)	45.0 (18)	40.0 (24)
138	18.2 (2)	40.0 (8)	35.0 (14)	36.7 (22)	27.3 (3)	35.0 (7)	42.5 (17)	40.0 (24)
139	36.4 (4)	40.0 (8)	35.0 (14)	36.7 (22)	27.3 (3)	45.0 (9)	57.5 (23)	53.3 (32)
140	27.3 (3)	30.0 (6)	35.0 (14)	33.3 (20)	18.2 (2)	45.0 (9)	52.5 (21)	50.0 (30)
141	54.5 (6)	40.0 (8)	32.5 (13)	35.0 (21)	18.2 (2)	45.0 (9)	65.0 (26)	58.3 (35)
142	72.7 (8)	40.0 (8)	42.5 (17)	41.7 (25)	9.1 (1)	40.0 (8)	55.0 (22)	50.0 (30)
143	54.5 (6)	50.0 (10)	40.0 (16)	43.3 (26)	36.4 (4)	35.0 (7)	57.5 (23)	50.0 (30)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED" INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	"UNRELATED" INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
144	63.6 (7)	45.0 (9)	35.0 (14)	38.3 (23)	18.2 (2)	45.0 (9)	62.5 (25)	56.7 (34)
145	27.3 (3)	40.0 (8)	32.5 (13)	35.0 (21)	27.3 (3)	40.0 (8)	65.0 (26)	56.7 (34)
146	36.4 (4)	30.0 (6)	30.0 (12)	30.0 (18)	18.2 (2)	55.0 (11)	70.0 (28)	65.0 (39)
147	36.4 (4)	50.0 (10)	47.5 (19)	48.3 (29)	18.2 (2)	20.0 (4)	32.5 (13)	28.3 (17)
148	27.3 (3)	40.0 (8)	45.0 (18)	43.3 (26)	27.3 (3)	35.0 (7)	52.5 (21)	46.7 (28)
149	54.5 (6)	30.0 (6)	32.5 (13)	31.7 (19)	27.3 (3)	40.0 (8)	65.0 (26)	56.7 (34)
150	45.4 (5)	45.0 (9)	25.0 (10)	31.7 (19)	27.3 (3)	50.0 (10)	75.0 (30)	66.7 (40)
151	36.4 (4)	40.0 (8)	57.5 (23)	35.0 (21)	27.3 (3)	35.0 (7)	30.0 (12)	31.7 (19)
152	72.7 (8)	40.0 (8)	42.5 (17)	41.7 (25)	18.2 (2)	40.0 (8)	40.0 (16)	40.0 (24)
153	63.6 (7)	35.0 (7)	35.0 (14)	35.0 (21)	27.3 (3)	50.0 (10)	45.0 (18)	46.7 (28)
154	45.4 (5)	40.0 (8)	47.5 (19)	45.0 (27)	27.3 (3)	55.0 (11)	40.0 (16)	45.0 (27)
155	63.6 (7)	40.0 (8)	32.5 (13)	35.0 (21)	36.4 (4)	55.0 (11)	60.0 (24)	58.3 (35)
156	63.6 (7)	40.0 (8)	22.5 (9)	28.3 (17)	27.3 (3)	55.0 (11)	72.5 (29)	66.7 (40)
157	45.4 (5)	25.0 (5)	27.5 (11)	26.7 (16)	36.4 (4)	65.0 (13)	55.0 (22)	58.3 (35)
158	27.3 (3)	15.0 (3)	30.0 (12)	25.0 (15)	63.6 (7)	80.0 (16)	70.0 (28)	73.3 (44)
159	54.5 (6)	5.0 (1)	32.5 (13)	23.3 (14)	36.4 (4)	80.0 (16)	57.5 (23)	65.0 (39)
160	36.4 (4)	20.0 (4)	37.5 (15)	31.7 (19)	27.3 (3)	70.0 (14)	47.5 (19)	55.0 (33)
161	36.4 (4)	35.0 (7)	30.0 (12)	31.7 (19)	27.3 (3)	50.0 (10)	60.0 (24)	56.7 (34)
162	45.4 (5)	55.0 (11)	45.0 (18)	48.3 (29)	27.3 (3)	35.0 (7)	47.5 (19)	43.3 (26)
163	54.5 (6)	60.0 (12)	35.0 (14)	43.3 (26)	36.4 (4)	30.0 (6)	62.5 (25)	51.7 (31)
164	54.5 (6)	40.0 (8)	22.5 (9)	28.3 (17)	45.4 (5)	55.0 (11)	77.5 (31)	70.0 (42)
165	36.4 (4)	35.0 (7)	25.0 (10)	28.3 (17)	63.6 (7)	60.0 (12)	75.0 (30)	70.0 (42)
166	63.6 (7)	55.0 (11)	65.0 (26)	61.7 (37)	9.1 (1)	10.0 (2)	17.5 (7)	15.0 (9)
167	72.7 (8)	65.0 (13)	52.5 (21)	56.7 (34)	27.3 (3)	25.0 (5)	42.5 (17)	36.7 (22)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED"				"UNRELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
168	63.6 (7)	35.0 (7)	42.5 (17)	40.0 (24)	36.4 (4)	40.0 (8)	50.0 (20)	46.7 (28)
169	54.5 (6)	55.0 (11)	62.5 (25)	60.0 (36)	18.2 (2)	(0)	(0)	(0)
170	63.6 (7)	45.0 (9)	27.5 (11)	33.3 (20)	36.4 (4)	45.0 (9)	65.0 (26)	58.3 (35)
171	63.6 (7)	50.0 (10)	45.0 (18)	46.7 (28)	9.1 (1)	10.0 (2)	17.5 (7)	15.0 (9)
172	63.6 (7)	60.0 (12)	37.5 (15)	45.0 (27)	27.3 (3)	20.0 (4)	50.0 (20)	40.0 (24)
173	45.4 (5)	50.0 (10)	65.0 (26)	60.0 (36)	27.3 (3)	5.0 (1)	10.0 (4)	8.3 (5)
174	72.7 (8)	50.0 (10)	35.0 (14)	40.0 (24)	27.3 (3)	30.0 (6)	57.5 (23)	48.3 (29)
175	63.6 (7)	45.0 (9)	30.0 (12)	35.0 (21)	36.4 (4)	35.0 (7)	67.5 (27)	56.7 (34)
176	63.6 (7)	60.0 (12)	50.0 (20)	53.3 (32)	27.3 (3)	10.0 (2)	35.0 (14)	26.7 (16)
177	36.4 (4)	55.0 (11)	57.5 (23)	56.7 (34)	54.5 (6)	25.0 (5)	37.5 (15)	33.3 (20)
178	45.4 (5)	50.0 (10)	50.0 (20)	50.0 (30)	45.4 (5)	25.0 (5)	42.5 (17)	36.7 (22)
179	54.5 (6)	40.0 (8)	40.0 (16)	40.0 (24)	27.3 (3)	30.0 (6)	45.0 (18)	40.0 (24)
180	54.5 (6)	25.0 (5)	37.5 (15)	33.3 (20)	27.3 (3)	45.0 (9)	52.5 (21)	50.0 (30)
181	54.5 (6)	40.0 (8)	30.0 (12)	33.3 (20)	36.4 (4)	50.0 (10)	65.0 (26)	60.0 (36)
182	45.4 (5)	35.0 (7)	32.5 (13)	33.3 (20)	45.4 (5)	50.0 (10)	62.5 (25)	58.3 (35)
183	45.4 (5)	30.0 (6)	37.5 (15)	35.0 (21)	45.4 (5)	65.0 (13)	62.5 (25)	63.3 (38)
184	45.4 (5)	50.0 (10)	50.0 (20)	50.0 (30)	27.3 (3)	15.0 (3)	32.5 (13)	26.7 (16)
185	45.4 (5)	40.0 (8)	40.0 (16)	40.0 (24)	45.4 (5)	45.0 (9)	60.0 (24)	55.0 (33)
186	63.6 (7)	40.0 (8)	50.0 (20)	46.7 (28)	9.1 (1)	25.0 (5)	30.0 (12)	28.3 (17)
187	45.4 (5)	50.0 (10)	45.0 (18)	46.7 (28)	18.2 (2)	(0)	17.5 (7)	11.7 (7)
188	45.4 (5)	30.0 (6)	42.5 (17)	38.3 (23)	18.2 (2)	15.0 (3)	22.5 (9)	20.0 (12)
189	45.4 (5)	20.0 (4)	37.5 (15)	31.7 (19)	18.2 (2)	25.0 (5)	30.0 (12)	28.3 (17)
190	63.6 (7)	30.0 (6)	45.0 (18)	40.0 (24)	18.2 (2)	35.0 (7)	37.5 (15)	36.7 (22)
191	63.6 (7)	30.0 (6)	35.0 (14)	33.3 (20)	9.1 (1)	30.0 (6)	45.0 (18)	40.0 (24)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED"				"UNRELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
192	54.5 (6)	35.0 (7)	45.0 (18)	41.7 (25)	9.1 (1)	20.0 (4)	25.0 (10)	23.3 (14)
193	63.6 (7)	40.0 (8)	35.0 (14)	36.7 (22)	18.2 (2)	35.0 (7)	47.5 (19)	43.3 (26)
194	81.8 (9)	25.0 (5)	37.5 (15)	33.3 (20)	18.2 (2)	40.0 (8)	50.0 (20)	46.7 (28)
195	81.8 (9)	20.0 (4)	40.0 (16)	33.3 (20)	18.2 (2)	55.0 (11)	55.0 (22)	55.0 (33)
196	54.5 (6)	25.0 (5)	52.5 (21)	43.3 (26)	18.2 (2)	30.0 (6)	32.5 (13)	31.7 (19)
197	72.7 (8)	40.0 (8)	42.5 (17)	41.7 (25)	27.3 (3)	40.0 (8)	55.0 (22)	50.0 (30)
198	63.6 (7)	50.0 (10)	35.0 (14)	40.0 (24)	36.4 (4)	45.0 (9)	62.5 (25)	56.7 (34)
199	36.4 (4)	15.0 (3)	30.0 (12)	25.0 (15)	18.2 (2)	35.0 (7)	40.0 (16)	38.3 (23)
200	27.3 (3)	10.0 (2)	27.5 (11)	21.7 (13)	18.2 (2)	40.0 (8)	42.5 (17)	41.7 (25)
201	27.3 (3)	15.0 (3)	27.5 (11)	23.3 (14)	18.2 (2)	40.0 (8)	42.5 (17)	41.7 (25)
202	36.4 (4)	15.0 (3)	37.5 (15)	30.0 (18)	18.2 (2)	55.0 (11)	45.0 (18)	48.3 (29)
203	81.8 (9)	55.0 (11)	30.0 (12)	38.3 (23)	9.1 (1)	5.0 (1)	15.0 (6)	11.7 (7)
204	63.6 (7)	40.0 (8)	32.5 (13)	35.0 (21)	18.2 (2)	5.0 (1)	20.0 (8)	15.0 (9)
205	72,7 (8)	30.0 (6)	42.5 (17)	38.3 (23)	9.1 (1)	(0)	20.0 (8)	13.3 (8)
206	45.4 (5)	40.0 (8)	42.5 (17)	41.7 (25)	(0)	(0)	30.0 (12)	20.0 (12)
207	72.7 (8)	35.0 (7)	45.0 (18)	41.7 (25)	(0)	30.0 (6)	45.0 (18)	40.0 (24)
208	54.5 (6)	40.0 (8)	17.5 (7)	25.0 (15)	45.4 (5)	55.0 (11)	80.0 (32)	71.7 (43)
209	54.5 (6)	35.0 (7)	60.0 (24)	51.7 (31)	9.1 (1)	10.0 (2)	27.5 (11)	21.7 (13)
210	45.4 (5)	55.0 (11)	45.0 (18)	48.3 (29)	(0)	(0)	17.5 (7)	11.7 (7)
211	54.5 (6)	55.0 (11)	52.5 (21)	53.3 (32)	9.1 (1)	10.0 (2)	20.0 (8)	16.7 (10)
212	45.4 (5)	50.0 (10)	57.5 (23)	55.0 (33)	18.2 (2)	(0)	17.5 (7)	11.7 (7)
213	54.5 (6)	60.0 (12)	30.0 (12)	40.0 (24)	9.1 (1)	30.0 (6)	57.5 (23)	48.3 (29)
214	54.5 (6)	45.0 (9)	25.0 (10)	31.7 (19)	27.3 (3)	50.0 (10)	70.0 (28)	63.3 (38)
215	45.4 (5)	20.0 (4)	42.5 (17)	35.0 (21)	9.1 (1)	5.0 (1)	2.5 (1)	3.3 (2)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED"				"UNRELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
216	54.5 (6)	45.0 (9)	45.0 (18)	45.0 (27)	27.3 (3)	40.0 (8)	52.5 (21)	48.3 (29)
217	45.4 (5)	45.0 (9)	42.5 (17)	43.3 (26)	36.4 (4)	40.0 (8)	55.0 (22)	50.0 (30)
218	45.4 (5)	50.0 (10)	22.5 (9)	31.7 (19)	45.4 (5)	45.0 (9)	72.5 (29)	63.3 (38)
219	63.6 (7)	55.0 (11)	45.0 (18)	48.3 (29)	27.3 (3)	35.0 (7)	47.5 (19)	43.3 (26)
220	54.5 (6)	45.0 (9)	40.0 (16)	41.7 (25)	27.3 (3)	50.0 (10)	52.5 (21)	51.7 (31)
221	36.4 (4)	40.0 (8)	17.5 (7)	25.0 (15)	54.5 (6)	60.0 (12)	80.0 (32)	73.3 (44)
222	72.7 (8)	50.0 (10)	57.5 (23)	55.0 (33)	9.1 (1)	35.0 (7)	30.0 (12)	31.7 (19)
223	72.7 (8)	60.0 (12)	62.5 (25)	61.7 (37)	9.1 (1)	25.0 (5)	22.5 (9)	23.3 (14)
224	72.7 (8)	25.0 (5)	37.5 (15)	33.3 (20)	27.3 (3)	65.0 (13)	57.5 (23)	60.0 (36)
225	72.7 (8)	60.0 (12)	40.0 (16)	46.7 (28)	18.2 (2)	25.0 (5)	47.5 (19)	40.0 (24)
226	72.7 (8)	20.0 (4)	30.0 (12)	26.7 (16)	18.2 (2)	70.0 (14)	60.0 (24)	63.3 (38)
227	81.8 (9)	45.0 (9)	40.0 (16)	41.7 (25)	18.2 (2)	40.0 (8)	50.0 (20)	46.7 (28)
228	63.6 (7)	30.0 (6)	40.0 (16)	36.7 (22)	36.4 (4)	50.0 (10)	57.5 (23)	55.0 (33)
229	45.4 (5)	55.0 (11)	42.5 (17)	46.7 (28)	18.2 (2)	40.0 (8)	47.5 (19)	45.0 (27)
230	36.6 (4)	35.0 (7)	47.5 (19)	43.3 (26)	27.3 (3)	55.0 (11)	45.0 (18)	48.3 (29)
231	54.5 (6)	15.0 (3)	30.0 (12)	25.0 (15)	18.2 (2)	75.0 (15)	65.0 (26)	68.3 (41)
232	45.4 (5)	40.0 (8)	22.5 (9)	28.3 (17)	27.3 (3)	55.0 (11)	72.5 (29)	66.7 (40)
233	54.5 (6)	10.0 (2)	20.0 (8)	16.7 (10)	36.4 (4)	80.0 (16)	77.5 (31)	78.3 (47)
234	45.4 (5)	15.0 (3)	20.0 (8)	18.3 (11)	45.4 (5)	80.0 (16)	77.5 (31)	78.3 (47)
235	45.4 (5)	20.0 (4)	37.5 (15)	31.7 (19)	36.4 (4)	65.0 (13)	60.0 (24)	61.7 (37)
236	36.6 (4)	20.0 (4)	27.5 (11)	25.0 (15)	45.4 (5)	70.0 (14)	70.0 (28)	70.0 (42)
237	27.3 (3)	15.0 (3)	22.5 (9)	20.0 (12)	63.6 (7)	75.0 (15)	75.0 (30)	75.0 (45)
238	36.4 (4)	15.0 (3)	17.5 (7)	16.7 (10)	63.6 (7)	80.0 (16)	80.0 (32)	80.0 (48)
239	45.4 (5)	40.0 (8)	20.0 (8)	26.7 (16)	36.4 (4)	55.0 (11)	75.0 (30)	68.3 (41)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED"				"UNRELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
240	45.4 (5)	25.0 (5)	22.5 (9)	23.3 (14)	36.4 (4)	65.0 (13)	72.5 (29)	70.0 (42)
241	54.5 (6)	40.0 (8)	32.5 (13)	35.0 (21)	45.4 (5)	55.0 (11)	70.0 (28)	65.0 (39)
242	54.5 (6)	40.0 (8)	27.5 (11)	31.7 (19)	45.4 (5)	55.0 (11)	70.0 (28)	65.0 (39)
243	63.6 (7)	45.0 (9)	30.0 (12)	35.0 (21)	36.4 (4)	50.0 (10)	65.0 (26)	60.0 (36)
244	54.5 (6)	50.0 (10)	35.0 (14)	40.0 (24)	36.4 (4)	45.0 (9)	62.5 (25)	56.7 (34)
245	54.5 (6)	45.0 (9)	27.5 (11)	33.3 (20)	45.4 (5)	55.0 (11)	67.5 (27)	63.3 (38)
246	63.6 (7)	65.0 (13)	35.0 (14)	45.0 (27)	27.3 (3)	30.0 (6)	52.5 (21)	45.0 (27)
247	27.3 (3)	15.0 (3)	20.0 (8)	18.3 (11)	63.6 (7)	85.0 (17)	80.0 (32)	81.7 (49)
248	72.7 (8)	45.0 (9)	50.0 (20)	48.3 (29)	(0)	40.0 (8)	42.5 (17)	41.7 (25)
249	72.7 (8)	40.0 (8)	55.0 (22)	50.0 (30)	9.1 (1)	40.0 (8)	42.5 (17)	41.7 (25)
250	54.5 (6)	45.0 (9)	42.5 (17)	43.3 (26)	18.2 (2)	40.0 (8)	57.5 (23)	51.7 (31)
251	54.5 (6)	45.0 (9)	40.0 (16)	41.7 (25)	18.2 (2)	40.0 (8)	60.0 (24)	53.3 (32)
252	54.5 (6)	35.0 (7)	25.0 (10)	28.3 (17)	9.1 (1)	60.0 (12)	67.5 (27)	65.0 (39)
253	54.5 (6)	40.0 (8)	45.0 (18)	43.3 (26)	(0)	5.0 (1)	12.5 (5)	10.0 (6)
254	63.6 (7)	40.0 (8)	25.0 (10)	30.0 (18)	9.1 (1)	50.0 (10)	65.0 (26)	60.0 (36)
255	81.8 (9)	50.0 (10)	32.5 (13)	38.3 (23)	9.1 (1)	40.0 (8)	57.5 (23)	51.7 (31)
256	72.7 (8)	45.0 (9)	25.0 (10)	31.7 (19)	18.2 (2)	45.0 (9)	70.0 (28)	61.7 (37)
257	54.5 (6)	50.0 (10)	42.5 (17)	45.0 (27)	18.2 (2)	45.0 (9)	47.5 (19)	46.7 (28)
258	36.4 (4)	40.0 (8)	25.0 (10)	30.0 (18)	27.3 (3)	50.0 (10)	65.0 (26)	60.0 (36)
259	36.4 (4)	40.0 (8)	22.5 (9)	28.3 (17)	27.3 (3)	55.0 (11)	70.0 (28)	65.0 (39)
260	54.5 (6)	35.0 (7)	27.5 (11)	30.0 (18)	18.2 (2)	40.0 (8)	55.0 (22)	50.0 (30)
261	54.5 (6)	35.0 (7)	32.5 (13)	33.3 (20)	9.1 (1)	50.0 (10)	55.0 (22)	53.3 (32)
262	45.4 (5)	35.0 (7)	30.0 (12)	31.7 (19)	18.2 (2)	50.0 (10)	62.5 (25)	58.3 (35)
263	72.7 (8)	50.0 (10)	25.0 (10)	33.3 (20)	9.1 (1)	50.0 (10)	65.0 (26)	60.0 (36)

TABLE - CONTINUED

CARD	"RELATED AND SOMEWHAT RELATED"				"UNRELATED"			
	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N	INSTRUCTORS n = 11 % N	SUPERVISORS n = 20 % N	SUPERVISEES n = 40 % N	ALL GRADUATES n = 60 % N
264	45.4 (5)	40.0 (8)	52.5 (21)	48.3 (29)	(0)	25.0 (5)	32.5 (13)	30.0 (18)
265	54.5 (6)	35.0 (7)	52.5 (21)	46.7 (28)	(0)	30.0 (6)	42.5 (17)	38.3 (23)
266	36.4 (4)	45.0 (9)	67.5 (27)	60.0 (36)	(0)	15.0 (3)	20.0 (8)	18.3 (11)
267	45.4 (5)	45.0 (9)	57.5 (23)	53.3 (32)	(0)	25.0 (5)	37.5 (15)	33.3 (20)
268	36.4 (4)	30.0 (6)	52.5 (21)	45.0 (27)	9.1 (1)	25.0 (5)	27.5 (11)	26.7 (16)
269	63.6 (7)	30.0 (6)	40.0 (16)	36.7 (22)	27.3 (3)	50.0 (10)	52.5 (21)	51.7 (31)
270	72.7 (8)	30.0 (6)	25.0 (10)	26.7 (16)	27.3 (3)	45.0 (9)	62.5 (25)	56.7 (34)
271	63.6 (7)	20.0 (4)	25.0 (10)	23.3 (14)	27.3 (3)	55.0 (11)	65.0 (26)	61.7 (37)
272	90.9 (10)	55.0 (11)	25.0 (10)	35.0 (21)	(0)	45.0 (9)	72.5 (29)	63.3 (38)
273	72.7 (8)	35.0 (7)	20.0 (8)	25.0 (15)	(0)	60.0 (12)	67.5 (27)	65.0 (39)
274	63.6 (7)	60.0 (12)	22.5 (9)	35.0 (21)	9.1 (1)	25.0 (5)	57.5 (23)	46.7 (28)
275	63.6 (7)	55.0 (11)	27.5 (11)	36.7 (22)	9.1 (1)	30.0 (6)	55.0 (22)	46.7 (28)
276	90.9 (10)	50.0 (10)	25.0 (10)	33.3 (20)	9.1 (1)	45.0 (9)	65.0 (26)	58.3 (35)
277	72.7 (8)	60.0 (12)	30.0 (12)	40.0 (24)	9.1 (1)	40.0 (8)	62.5 (25)	55.0 (33)
278	45.4 (5)	30.0 (6)	25.0 (10)	26.7 (16)	36.4 (4)	65.0 (13)	72.5 (29)	70.0 (42)